DLRGROUP

ARCHITECTURE ENGINEERING PLANNING INTERIORS

KLEIN ISD - SCHINDEWOLF GYM ADDITION

SPRING, TEXAS

Project Manual

100% CONSTRUCTION DOCUMENTS

DLR Group Project No. 39-25107-00

8 JANUARY 2025

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NOT USED

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DLR Group inc.
1000 Louisiana Street, Suite 1100, Houston, Texas 77002
Phone: (713)-561-392

January 8, 2025

SECTION 001113 - ADVERTISEMENT TO BID

Klein Independent School District
Schindewolf Gym Addition
20903 Ella Blvd
Spring, Texas 77388
DLR Group Project No. 39-25107-00

Klein Independent School District will receive Bids for a Combined Contract, including General Construction, Mechanical, and Electrical Work, for an addition and renovation to Schindewolf Intermediate School located at 20903 Ella Blvd, Spring, Texas 77388. The addition is two (2) stories in height, and has a total area of approximately thirteen thousand (13,000) square feet.

Bids must be on a Lump Sum basis.

Bids will be received until 2:00 PM (CST), on Tuesday, January 28, 2025, by Danny Phillips at Klein Independent School District Multipurpose Center, 7500 FM 2920, Klein, Texas 77379. Bids received after this time will not be accepted.

Bids will be publicly opened and read aloud immediately and simultaneously in the presence of bidders, or representatives of bidders, when the hour is reached for the bids to close.

PRE-BID CONFERENCE: The Architect will hold a Pre-Bid Conference at Schindewolf Intermediate School located at 20903 Ella Blvd, Spring, Texas 77388 on Tuesday, January 14, 2025, 10:00 AM (CST). All prime Bidders are encouraged to attend.

Electronic Bidding Documents may be obtained from the office the Architect, DLR Group inc., 1000 Louisiana Street, Suite 1100, Houston, Texas 77002, after January 8, 2025, by contacting Paul Kenney, RA, pkenney@DLRGROUP.com, office phone (713) 561-3925, mobile phone(409) 201-9843.

Bid Security in the amount of ten percent (10%) of the Bid must accompany each Bid in accordance with the Instructions to Bidders.

All Bidders are subject to and must comply with applicable state and federal anti-discrimination laws.

Attention is called to the fact that not less than the minimum salaries and wages as set forth in the Bidding Documents must be paid on this project in conformity with the laws of the State of Texas.

The Owner reserves the right to reject any or all Bids and to waive informalities or irregularities in the Bidding.

Danny Phillips, RTSBO, AIC, CPC, Executive Director Department of Capital Projects
Klein Independent School District, 7200 Spring Cypress Road, Klein, Texas 77379

END OF SECTION 001113

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SECTION 002113 - INSTRUCTIONS TO BIDDERS

To be considered, Bids must be made in accord with these Instructions to Bidders.

IB.01 DEFINITION: Bidding Documents include the Advertisement to Bid, Instructions to Bidders, Bid Form, other sample bidding and contract forms, and proposed Contract Documents including any Addenda issued prior to receipt of Bids.

IB.02 BIDDING DOCUMENTS

IB.02.1 ELECTRONIC COPIES of Bidding Documents may be obtained from the office the Architect, DLR Group inc., 1000 Louisiana Street, Suite 1100, Houston, Texas 77002, after January 8, 2025, by contacting Paul Kenney, RA, pkenney@DLRGROUP.com, office phone (713) 561-3925, mobile phone (409) 201-9843.

IB.02.2 QUESTIONS AND INTERPRETATIONS: Submit questions about Bidding Documents to the Architect. Replies will be issued to Prime Bidders of record as Addenda to the Bidding Documents. The Architect and the Owner will not be responsible for oral clarification. Questions received less than seventy-two (72) hours before the Bid opening cannot be answered.

IB.02.3 SUBSTITUTIONS: To obtain approval to use unspecified products, Bidders shall submit completed “Procurement Substitution Request Form” located at the end of the “Procurement Substitution Procedures” at least ten (10) days before the Bid date and hour. Requests received after this time will not be considered. Such requests shall include the name of the project, the specification section and the name of the material or equipment for which it is to be substituted and a complete description of the proposed substitution including drawings, performance and test data, and other information necessary for an evaluation. A statement setting forth changes in other materials, equipment, or other portions of the Work, including changes in the work of other contracts that incorporation of the proposed substitution would require, shall be included. The burden of proof of the merit of the proposed substitution is upon the proposer. The Architect’s decision of approval or disapproval of a proposed substitution shall be final. If the product is acceptable, the Architect-Engineer will approve it in an Addendum issued to Prime Bidders of record. After the Contract is awarded, substitutions will be considered only under circumstances set forth in Division 01 Section 012500 "Substitution Procedures" and submitted on “Post-Bid Request For Substitution Form” located at end of that Section.

IB.02.4 PRE-BID CONFERENCE: The Architect will hold a Pre-Bid Conference at Schindewolf Intermediate School located at 20903 Ella Blvd, Spring, Texas 77388 on Tuesday, January 14, 2025, 10:00 AM (CST). All prime Bidders are encouraged to attend.

IB.03 CONDITIONS OF WORK

IB.03.1 EXAMINATION: Bidders shall carefully examine the Bidding Documents and construction site to obtain firsthand knowledge of existing conditions. The Contractors will not be given extra payments for conditions which can be determined by examining the site and Bidding Documents. Appointments for examining the existing building may be made by calling Christopher Hazzan, Construction Project Manager at (832) 249-5207. A 24-hour notice is required and Bidders are required to check in at the School’s Administrative office upon arrival.

IB.03.2 TEXAS SALES TAX: The Owner is exempt from the Texas Sales Tax on incorporated materials, consumable supplies, and normally taxable services in accordance with the State of Texas Tax Code.

IB.03.3 PREVAILING WAGES. Laborers and mechanics employed on the project shall be paid wages at rates prevailing on similar construction in the locality as determined by the Secretary of Labor in accord with the Davis-Bacon Act as amended and in conformity with the laws of the State of Texas. Refer to attached wage rate document included at the end of this Section.

IB.04 BIDDING PROCEDURE

IB.04.1 PREPARATION OF BIDS

.1 Bids shall be submitted on unaltered Bid Forms furnished by the Architect-Engineer.

.2 Each Bid shall include the legal name of the Bidder, and shall show whether the Bidder is a corporation, a partnership, or a sole proprietor, or any other legal entity. A Bid of a corporation shall give the State of incorporation, and shall have the seal affixed. A Bid of a partnership shall give the names of all the partners. A Bid of a sole proprietor doing business under a trade name shall give the name of the sole proprietor and the trade name under which the individual is doing business.

.3 Fill in all blank spaces for bid prices in ink or typewritten words, and submit one (1) copy. The Bidder must include all Unit Cost items and all Alternates if shown on the Bid Form. No segregated or qualified bids will be accepted.

.4 Bidders submitting Bids for Combined Contracts shall enter the names of the Prime Subcontractors in blanks provided on the Bid Form.

.5 Bids shall be signed by the person or persons legally authorized to bind the Bidder to a contract. A Bid submitted by an agent shall have a current Power of Attorney attached certifying the agent's authority to bind the Bidder.

IB.04.2 BID SECURITY

.1 Certified check or cashier's check payable to Klein Independent School District, in the amount of ten percent (10%) of the amount of the Bid, or a Bid Bond executed by the Bidder in the amount of ten percent (10%) of the amount of the Bid, shall be submitted with each Bid.

.2 If, within ten (10) days after notice of acceptance of his Bid, the Bidder refuses to enter into a contract or fails to furnish bonds, as described in these Instructions to Bidders, for the faithful performance of the Contract and payment of obligations arising thereunder, the amount of the bid security shall be forfeited to the Owner as liquidated damages, not as a penalty.

.3 If a Bid Bond is submitted, it shall be issued by a surety company authorized by the State of Texas to issue such bonds, shall be acceptable to the Owner, and shall be submitted on AIA Document A310, February 1970 or later edition; and the Attorney-In-Fact who executes the bond on behalf of the surety shall affix to the bond a certified and current copy of his Power of Attorney.

.4 Bid Security of the three (3) lowest Bidders will be retained until a contract is signed and required bonds and insurance are filed, the specified time has elapsed so that Bids may be withdrawn, or all Bids have been rejected.

.5 Bid Security shall be enclosed with the Bid.

IB.04.3 SUBMISSION OF BIDS

.1 Bids, together with required enclosures, shall be submitted in opaque, sealed envelopes bearing on the outside the Bidder's name and address, the Project name, and the portion of the project or category of work for which the Bid is submitted.

.2 Bids sent by mail shall be enclosed in a separate mailing envelope with the notation "BID ENCLOSED" on the face, and shall be addressed to the Owner as shown on the Bid Form.

.3 Bids shall be deposited at the designated location prior to the time and date of receipt of Bids indicated in the Advertisement to Bid. Bids received after the time and date for receipt of Bids will be returned unopened.

IB.04.4 MODIFICATION OR WITHDRAWAL OF BID

.1 Bid may not be modified, withdrawn, or canceled by the Bidder until sixty (60) days after the time and date for receipt of Bids.

.2 Prior to the time and date for receipt of Bids, Bids submitted early may be modified or withdrawn only by notice to the party receiving Bids at the place and prior to the time designated for receipt of Bids. Such notice shall be in writing over the signature of the Bidder or by facsimile. Modifications shall be so worded as not to reveal the amount of the original Bid.

.3 Withdrawn Bids may be resubmitted up to the time designated for the receipt of Bids.

.4 Bid Security shall be sufficient for the Bid as modified or resubmitted.

IB.05 CONSIDERATION OF BIDS

IB.05.1 OPENING OF BIDS. Bids will be publicly opened and read aloud immediately and simultaneously in the presence of bidders, or representatives of bidders, when the hour is reached for the bids to close.

IB.05.2 REJECTION OF BIDS, INFORMALITIES AND IRREGULARITIES. The Owner shall have the right to reject any or all Bids and to reject Bids not accompanied by required bid security or data required by the Bidding Documents or in any way incomplete or irregular. The Owner shall have the right to waive any informality or irregularity in any Bid received.

IB.05.3 ACCEPTANCE OF BID

.1 The Owner shall have the right to accept Alternates in any order or combination and to determine the low Bidder on the basis of the sum of the Base Bid and the Alternates accepted.

.2 It is the intent of the Owner to award a contract to the lowest responsible Bidder provided the Bid has been submitted in accord with the requirements of the Bidding Documents, is judged reasonable, and does not exceed the funds available.

IB.06 QUALIFICATION OF CONTRACTORS

IB.06.1 QUALIFICATION STATEMENT. The Bidder shall submit with his Bid a properly executed Contractor's Qualification Statement on AIA Document A305. If the Bidder has on file with the Architect-Engineer a current Contractor's Qualification Statement, he need not submit one with his Bid.

IB.06.2 DISQUALIFICATION. The Owner reserves the right to disqualify Bids, before or after opening, upon evidence of collusion with the intent to defraud or other illegal practices upon the part of the Bidder.

IB.07 POST-BID INFORMATION AND SUBMITTALS

IB.07.1 PERFORMANCE BOND AND LABOR AND MATERIAL PAYMENT BOND covering the faithful performance of the Contract and the payment of all obligations arising thereunder, each in the amount of one hundred percent (100%) of the Contract Sum, shall be submitted in duplicate to the Architect-Engineer, together with the executed Owner-Contractor Agreements, within ten (10) days after notification of award of the Contract. Such bonds shall be issued by a surety company acceptable to the Owner and properly licensed in the State of Texas, and shall be on AIA Document A312, December 1984 edition.

IB.07.2 FORM OF AGREEMENT FOR THE WORK will be written on the Standard Form of Agreement Between Owner and Contractor where the basis of payment is a Stipulated Sum, AIA Document A101. A draft copy of which is attached at the end of these Instructions to Bidders.

.1 INSURANCE AND BONDS requirements are set forth in Document 007300A Supplementary Conditions to the AIA Document A201-2017 General Conditions of the Contract for Construction.

END OF SECTION 002113

RESOLUTION OF THE BOARD OF TRUSTEES OF THE
KLEIN INDEPENDENT SCHOOL DISTRICT

The Board of Trustees of the Klein Independent School District (the "District") hereby makes the following findings in connection with District facilities projects:

1. Texas Government Code Chapter 2258 requires a current analysis of Prevailing Wage Rates in connection with construction of a public building with public funds;

2. PBK Architects, Inc., on behalf of public school districts in the Gulf Coast market area, conducted a survey (the "Study") of Prevailing Wage Rates for construction trades in accordance with the requirements of Texas Government Code Chapter 2258;

3. PBK Architects, Inc. has expressly authorized the District's use of the Study attached hereto as Exhibit "A."

BE IT, THEREFORE, RESOLVED that the Klein Independent School District hereby adopts the Prevailing Wages reflected in the Study for use on all District facilities projects.

Passed the 12 day of September, 2022.

Ronnie Anderson
President, Board of Trustees
Klein Independent School District

Attest:
Cathy Arellano
Secretary, Board of Trustees
Klein Independent School District

Exhibit A

Prevailing Wage Rate Determination Information

The following information is from Chapter 2258 Texas Government Code:

Sec. 2258.021. Right to be Paid Prevailing Wage Rates.

(a) A worker employed on a public work by or on behalf of the state or a political subdivision of the state shall be paid:
    (1) not less than the general prevailing rate of per diem wages for work of a similar character in the locality in which the work is performed; and
    (2) not less than the general prevailing rate of per diem wages for legal holiday and overtime work.
(b) Subsection (a) does not apply to maintenance work.
(c) A worker is employed on a public work for the purposes of this section if the worker is employed by a contractor or subcontractor in the execution of a contract for the public work with the state, a political subdivision of the state, or any officer or public body of the state or a political subdivision of the state.

Sec. 2258.023. Prevailing Wage Rates to be paid by Contractor and Subcontractor; Penalty.

(a) The contractor who is awarded a contract by a public body or a subcontractor of the contractor shall pay not less than the rates determined under Section 2258.022 to a worker employed by it in the execution of the contract.
(b) A contractor or subcontractor who violates this section shall pay to the state or a political subdivision of the state on whose behalf the contract is made, $60 for each worker employed for each calendar day or part of the day that the worker is paid less than the wage rates stipulated in the contract. A public body awarding a contract shall specify this penalty in the contract.
(c) A contractor or subcontractor does not violate this section if a public body awarding a contract does not determine the prevailing wage rates and specify the rates in the contract as provided by Section 2258.022.
(d) The public body shall use any money collected under this section to offset the costs incurred in the administration of this chapter.
(e) A municipality is entitled to collect a penalty under this section only if the municipality has a population of more than 10,000.

Sec. 2258.051. Duty of Public Body to Hear Complaints and Withhold Payment.

A public body awarding a contract, and an agent or officer of the public body, shall:

(1) take cognizance of complaints of all violations of this chapter committed in the execution of the contract; and
(2) withhold money forfeited or required to be withheld under this chapter from the payments to the contractor under the contract, except that the public body may not withhold money from other than the final payment without a determination by the public body that there is good cause to believe that the contractor has violated this chapter.

Prevailing Wage Rates – School Construction Trades

June 1, 2022

Texas Gulf Coast Area

CLASSIFICATION	2022 HOURLY RATE
ASBESTOS WORKER	$21.13
BRICKLAYER; MASON	$25.32
CARPENTER; CASEWORKER	$23.38
CARPET LAYER; FLOOR INSTALLER	$25.12
CONCRETE FINISHER	$23.40
DATA COMM/TELE COMM	$23.50
DRYWALL INSTALLER; CEILING INSTALLER	$26.65
ELECTRICIAN	$25.93
ELEVATOR MECHANIC	$28.80
FIREPROOFING INSTALLER	$22.25
GLAZIER	$22.30
HEAVY EQUIPMENT OPERATOR	$22.40
INSULATOR	$20.50
IRONWORKER	$25.50
LABORER, HELPER	$16.71
LATHERER; PLASTERER	$23.25
LIGHT EQUIPMENT OPERATOR	$20.50
METAL BUILDING ASSEMBLER	$21.10
MILLWRIGHT	$33.63
PAINTER; WALL COVERING INSTALLER	$19.60
PIPEFITTER	$26.97
PLUMBER	$26.71
ROOFER	$20.50
SHEET METAL WORKER	$19.90
SPRINKLER FITTER	$26.13
STEEL ERECTOR	$23.25
TERRAZZO WORKER	$23.50
TILE SETTER	$19.58
WATERPROOFER; CAULKER	$19.88

This document was developed by PBK Architects, Inc., in strict accordance with Chapter 2258 of the Texas Government Code.

Prevailing Wage Rates

Worker Classification Definition Sheet

CLASSIFICATION	DEFINITION
ASBESTOS WORKER	Worker who removes and disposes of asbestos materials.
BRICKLAYER; MASON	Craftsman who works with masonry products, stone, brick, block, or any material substituting those materials and accessories.
CARPENTER; CASEWORKER	Worker who build wood structures or structures of any material which has replaces wood. Includes rough and finish carpentry, hardware and trim.
CARPET LAYER; FLOOR INSTALLER	Worker who installs carpets and /or floor coverings, vinyl tile.
CONCRETE FINISHER	Worker who floats, trowels, and finishes concrete.
DATA COMM/TELE COMM	Worker who installs data/telephone and television cable and associate equipment and accessories.
DRYWALL; CEILING INSTALLER	Worker who installs metal framed walls and ceiling, drywall coverings, ceiling grids, and ceilings.
ELECTRICIAN	Skilled craftsman who installs or repairs electrical wiring and devices. Includes fire alarm systems and HVAC electrical controls.
ELEVATOR MECHANIC	Craftsman skilled in the installation and maintenance of elevators.
FIREPROOFING INSTALLER	Worker who sprays or applies fire proofing materials.
GLAZIER	Worker who installs glass, glazing, and glass framing.
HEAVY EQUIPMENT OPERATOR	Includes but not limited to: all CAT tractors, all derrick-powered, all power operated cranes, back-hoes, back-fillers, power operated shovels, winch trucks, and all trenching machines.
INSULATOR	Worker who applies, sprays, or installs insulation.
IRONWORKER	Skilled craftsman who erects structural steel framing, and installs structural concrete Rebar.
LABORER, HELPER	Worker qualified for only unskilled or semi-skilled work. Lifting, carrying materials or tools, hauling, digging, clean up.
LATHERER; PLASTERER	Worker who installs metal framing and lath. Worker who applies plaster to lathing and installs associated accessories.
LIGHT EQUIPMENT OPERATOR	Includes but not limited to , air compressors, truck crane drivers, flex planes, building elevators, form graders, concrete mixers less than 14cf), conveyers.
METAL BUILDING ASSEMBLER	Worker who assembles pre-made metal buildings.
MILLWRIGHT	Mechanic specializing in the installation of heavy machinery, conveyance, wrenches, dock levelers, hydraulic lifts, and align pumps.
PAINTER; WALL COVERING INSTALLER	Worker who prepares wall surfaces and applies paint and/or wall coverings, tape, and bedding.
PIPEFITTER	Trained worker who installs piping systems, chilled water piping and hot water (boiler) piping, pneumatic tubing controls, chillers, boilers, and associated mechanical equipment.
PLUMBER	Skilled craftsman who installs domestic hot and cold water piping, waste piping, storm system piping, water closets, sinks, urinals, and related work.
ROOFER	Worker who installs roofing materials, Bitumen (asphalt and coal tar) felts, flashings, all types of roofing membranes, and associated products.
SHEET METAL WORKER	Worker who installs sheet metal products, Roof metal, flashings and curbs, ductwork, mechanical equipment, and associated metals.
SPRINKLER FITTER	Worker who installs fire sprinklers systems and fire protectant equipment.
STEEL ERECTOR	Worker who erects and dismantles structural steel frames of buildings and other structures.
TERRAZZO WORKER	Craftsman who places and finishes Terrazzo
TILE SETTER	Worker who prepares wall and/or floor surfaces and applies ceramic tiles to these surfaces.
WATERPROOFER; CAULKER	Worker who applies water proofing material to buildings. Products include sealant, caulk, sheet membranes, and liquid membranes, sprayed, rolled or brushed.

DRAFT

AIA® Document A101® – 2017

Standard Form of Agreement Between Owner and Contractor

where the basis of payment is a Stipulated Sum

AGREEMENT made as of the « » day of « » in the year « »
(In words, indicate day, month and year.)

BETWEEN the Owner:
(Name, legal status, address and other information)

«Klein Independent School District»«»
« 7200 Spring Cypress Road»
«Klein, Texas 77379»
«»

and the Contractor:
(Name, legal status, address and other information)

«»«»
« »
« »
«»

for the following Project:
(Name, location and detailed description)

«Schindewolf Gym Addition»
«20903 Ella Blvd»
«Spring, Texas 77388»

The Architect:
(Name, legal status, address and other information)

«DLR Group inc. of Texas, a Texas corporation »«»
«1000 Louisiana Street»
«Suite 1100 »
«Houston, Texas 77002 »

The Owner and Contractor agree as follows.

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.

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

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

ELECTRONIC COPYING of any portion of this AIA® Document to another electronic file is prohibited and constitutes a violation of copyright laws as set forth in the footer of this document.

TABLE OF ARTICLES

ARTICLE 1 THE CONTRACT DOCUMENTS

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

ARTICLE 2 THE WORK OF THIS CONTRACT

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

ARTICLE 3 DATE OF COMMENCEMENT AND SUBSTANTIAL COMPLETION

§ 3.1 The date of commencement of the Work shall be:
(Check one of the following boxes.)

[ ] The date of this Agreement.

[ ] A date set forth in a notice to proceed issued by the Owner.

[ ] Established as follows:
(Insert a date or a means to determine the date of commencement of the Work.)

« »

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

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

§ 3.3 Substantial Completion

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

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

[ ] Not later than « » (« ») calendar days from the date of commencement of the Work.

[« X »] By the following date: « »

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

Portion of Work	Substantial Completion Date

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

ARTICLE 4 CONTRACT SUM

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

§ 4.2 Alternates

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

Item	Price

§ 4.2.2 Subject to the conditions noted below, the following alternates may be accepted by the Owner following execution of this Agreement. Upon acceptance, the Owner shall issue a Modification to this Agreement.
(Insert below each alternate and the conditions that must be met for the Owner to accept the alternate.)

Item	Price	Conditions for Acceptance

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

Item	Price
Owner's Contingency Allowance	$400,000.00

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

Item	Units and Limitations	Price per Unit ($0.00)

§ 4.5 Liquidated damages, if any:
(Insert terms and conditions for liquidated damages, if any.)

«$1,000.00 per calendar day after Substantial Completion and $100.00 per calendar day after sixty (60) days past Substantial Completion as set forth in Section 8.3.4 and 8.3.5 of the AIA Document A201.»

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

« »

ARTICLE 5 PAYMENTS

§ 5.1 Progress Payments

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

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

« »

§ 5.1.3 Provided that an Application for Payment is received by the Architect not later than the «Third » day of a month, the Owner shall make payment of the amount certified to the Contractor not later than the «Twentieth » day of the «Same » month. If an Application for Payment is received by the Architect after the application date fixed above, payment of the amount certified shall be made by the Owner not later than «Thirty » (« 30 ») days after the Architect receives the Application for Payment.
(Federal, state or local laws may require payment within a certain period of time.)

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

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

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

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

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

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

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

§ 5.1.7 Retainage

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

«Five (5) Percent »

§ 5.1.7.1.1 The following items are not subject to retainage:
(Insert any items not subject to the withholding of retainage, such as general conditions, insurance, etc.)

« At the Owner's Sole Discretion »

§ 5.1.7.2 Reduction or limitation of retainage, if any, shall be as follows:
(If the retainage established in Section 5.1.7.1 is to be modified prior to Substantial Completion of the entire Work, including modifications for Substantial Completion of portions of the Work as provided in Section 3.3.2, insert provisions for such modifications.)

« »

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

« »

§ 5.1.8 If final completion of the Work is materially delayed through no fault of the Contractor, the Owner shall pay the Contractor any additional amounts in accordance with Article 9 of AIA Document A201–2017.

§ 5.1.9 Except with the Owner's prior approval, the Contractor shall not make advance payments to suppliers for materials or equipment which have not been delivered and stored at the site.

§ 5.2 Final Payment

§ 5.2.1 Final payment, constituting the entire unpaid balance of the Contract Sum, shall be made by the Owner to the Contractor when

.1 the Contractor has fully performed the Contract except for the Contractor's responsibility to correct Work as provided in Article 12 of AIA Document A201–2017, and to satisfy other requirements, if any, which extend beyond final payment; and

.2 a final Certificate for Payment has been issued by the Architect.

§ 5.2.2 The Owner's final payment to the Contractor shall be made no later than 30 days after the issuance of the Architect's final Certificate for Payment, or as follows:

«See Supplementary Conditions to AIA Document A101-2017 »

§ 5.3 Interest

Payments due and unpaid under the Contract shall bear interest from the date payment is due at the rate stated below, or in the absence thereof, at the legal rate prevailing from time to time at the place where the Project is located.
(Insert rate of interest agreed upon, if any.)

« Zero » % « Per annum »

ARTICLE 6 DISPUTE RESOLUTION

§ 6.1 Initial Decision Maker

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

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

[ ] Arbitration pursuant to Section 15.4 of AIA Document A201–2017

[« X »] Litigation in a court of competent jurisdiction

[ ] Other *(Specify)*

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

ARTICLE 7 TERMINATION OR SUSPENSION

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

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

«NA »

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

ARTICLE 8 MISCELLANEOUS PROVISIONS

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

§ 8.2 The Owner's representative:
(Name, address, email address, and other information)

«Danny Phillips »
«Executive Director of Capital Projects »
«Klein ISD »
«7520 FM 2920 »
«Klein, Texas 77379- »
«Telephone (832) 249-4240- »

§ 8.3 The Contractor's representative:
(Name, address, email address, and other information)

« »
« »
« »
« »
« »
« »

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

§ 8.5 Insurance and Bonds

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

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

§ 8.6 Notice in electronic format, pursuant to Article 1 of AIA Document A201–2017, may be given in accordance with AIA Document E203™–2013, Building Information Modeling and Digital Data Exhibit, if completed, or as otherwise set forth below:

(If other than in accordance with AIA Document E203–2013, insert requirements for delivering notice in electronic format such as name, title, and email address of the recipient and whether and how the system will be required to generate a read receipt for the transmission.)

« »

§ 8.7 Other provisions:

« »

ARTICLE 9 ENUMERATION OF CONTRACT DOCUMENTS

§ 9.1 This Agreement is comprised of the following documents:

.1 AIA Document A101™–2017, Standard Form of Agreement Between Owner and Contractor

.2 AIA Document A101™–2017, Exhibit A, Insurance and Bonds

.3 AIA Document A201™–2017, General Conditions of the Contract for Construction

.4 AIA Document E203™–2013, Building Information Modeling and Digital Data Exhibit, dated as indicated below:

(Insert the date of the E203-2013 incorporated into this Agreement.)

«NA »

.5 Drawings

Number	Title	Date

.6 Specifications

Section	Title	Date	Pages

.7 Addenda, if any:

Number	Date	Pages
Addendum 1		

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

.8 Other Exhibits:

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

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

« »

[« »] The Sustainability Plan:

Title	Date	Pages

[« X »] Supplementary and other Conditions of the Contract:

Document	Title	Date	Pages
Exhibit A	Supplementary Conditions	10/03/2023	29

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

« »

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

OWNER *(Signature)*	**CONTRACTOR** *(Signature)*
« »« »	« »« »
(Printed name and title)	*(Printed name and title)*

DOCUMENT 002600 - PROCUREMENT SUBSTITUTION PROCEDURES

1.1 DEFINITIONS

A. Procurement Substitution Requests: Requests for changes in products, materials, equipment, and methods of construction from those indicated in the Procurement and Contracting Documents, submitted prior to receipt of bids.

B. Substitution Requests: Requests for changes in products, materials, equipment, and methods of construction from those indicated in the Contract Documents, submitted following Contract award. See Section 012500 "Substitution Procedures" for conditions under which Substitution requests will be considered following Contract award.

1.2 QUALITY ASSURANCE

A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage a qualified testing agency to perform compatibility tests recommended by manufacturers.

1.3 PROCUREMENT SUBSTITUTIONS

A. Procurement Substitutions, General: By submitting a bid, the Bidder represents that its bid is based on materials and equipment described in the Procurement and Contracting Documents, including Addenda. Bidders are encouraged to request approval of qualifying substitute materials and equipment when the Specifications Sections list materials and equipment by product or manufacturer name.

B. Procurement Substitution Requests will be received and considered by Owner when the following conditions are satisfied, as determined by Architect; otherwise requests will be returned without action:

1. Extensive revisions to the Contract Documents are not required.
2. Proposed changes are in keeping with the general intent of the Contract Documents, including the level of quality of the Work represented by the requirements therein.
3. The request is fully documented and properly submitted.

1.4 SUBMITTALS

A. Procurement Substitution Request: Submit to Architect. Procurement Substitution Request must be made in writing in compliance with the following requirements:

1. Requests for substitution of materials and equipment will be considered if received no later than 10 days prior to date of bid opening.
2. Submittal Format: Submit one copy of each written Procurement Substitution Request, using CSI Substitution Request Form 1.5C or form included at the end of this Section.

3. Submittal Format: Submit Procurement Substitution Request, using format provided on Project Web site.

    a. Identify the product or the fabrication or installation method to be replaced in each request. Include related Specifications Sections and drawing numbers.
    b. Provide complete documentation on both the product specified and the proposed substitute, including the following information as appropriate:

        1) Point-by-point comparison of specified and proposed substitute product data, fabrication drawings, and installation procedures.
        2) Copies of current, independent third-party test data of salient product or system characteristics.
        3) Samples where applicable or when requested by Architect.
        4) Detailed comparison of significant qualities of the proposed substitute with those of the Work specified. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.
        5) Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
        6) Research reports, where applicable, evidencing compliance with building code in effect for Project, from ICC-ES.
        7) Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by Owner and separate contractors, which will become necessary to accommodate the proposed substitute.

    c. Provide certification by manufacturer that the substitute proposed is equal to or superior to that required by the Procurement and Contracting Documents, and that its in-place performance will be equal to or superior to the product or equipment specified in the application indicated.
    d. Bidder, in submitting the Procurement Substitution Request, waives the right to additional payment or an extension of Contract Time because of the failure of the substitute to perform as represented in the Procurement Substitution Request.

B. Architect's Action:

1. Architect may request additional information or documentation necessary for evaluation of the Procurement Substitution Request. Architect will notify all bidders of acceptance of the proposed substitute by means of an Addendum to the Procurement and Contracting Documents.

C. Architect's approval of a substitute during bidding does not relieve Contractor of the responsibility to submit required shop drawings and to comply with all other requirements of the Contract Documents.

END OF DOCUMENT 002600

PROCUREMENT SUBSTITUTION REQUEST FORM 002600A

To: DLR Group inc.
1000 Louisiana Street, Suite 1100
Houston, Texas 77002
TEL: (713) 561-3925

PROJECT: _____

We hereby submit for your consideration the following product as substitute for specified item for the above project:

Section	Page	Paragraph/Line	Specified Item

Proposed Substitution:

Attach complete product description, drawings, photographs, performance and test data, warranty, information and other information necessary for evaluation. Identify specific model numbers, finishes, options, etc.

A. Will changes be required to building design or drawing dimensions in order to properly install proposed substitution? Yes__ No__. If yes, explain.

_____

B. Will the undersigned pay for changes to the building design, including engineering and drawings costs, caused by requested substitution? Yes__ No__.

C. Differences between proposed substitution and specified item.

_____

_____

D. What affect does substitution have on other trades? _____

_____

E. Does manufacturer's warranty of the proposed substitution differ from that specified? Yes__ No_____.

If yes, explain _____

_____

Submitted by:

_____
Signature

_____
Firm

_____
Address

_____

Date: _____

Telephone:_____

For Architect's Use Only:

__Accepted __Accepted as Noted

___Not Accepted ___Received Too Late

By:_____
Date:_____
Remarks:_____

_____

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DOCUMENT 003132 - GEOTECHNICAL DATA

1.1 GEOTECHNICAL DATA

A. This Document with its referenced attachments is part of the Procurement and Contracting Requirements for Project. They provide Owner's information for Bidders' convenience and are intended to supplement rather than serve in lieu of Bidders' own investigations. They are made available for Bidders' convenience and information. This Document and its attachments are not part of the Contract Documents.

B. Because subsurface conditions indicated by the soil borings are a sampling in relation to the entire construction area, and for other reasons, the Owner, the Architect, the Architect's consultants, and the firm reporting the subsurface conditions do not warranty the conditions below the depths of the borings or that the strata logged from the borings are necessarily typical of the entire site. Any party using the information described in the soil borings and geotechnical report shall accept full responsibility for its use.

C. A geotechnical investigation report for Project, prepared by CMT Technical Services, dated November 4, 2024, is available for viewing as appended to this Document.

1. The opinions expressed in this report are those of a geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by a geotechnical engineer. Owner is not responsible for interpretations or conclusions drawn from the data.
2. Any party using information described in the geotechnical report shall make additional test borings and conduct other exploratory operations that may be required to determine the character of subsurface materials that may be encountered.

D. Related Requirements:

1. Document 002113 "Instructions to Bidders" for the Bidder's responsibilities for examination of Project site and existing conditions.

END OF DOCUMENT 003132

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Geotechnical Study
Schindewolf Intermediate School
New Gymnasium
20903 Ella Boulevard
Spring, Texas

Prepared For

Klein ISD
Klein, Texas

Prepared By

CMT Technical Services
formerly Paradigm Consultants, Inc.
9980 West Sam Houston Pkwy. South, Suite 500
Houston, Texas 77099
TBPE Reg. No. F-001478

November 2024

November 4, 2024
CMT Project No. 24-1062

9980 W. Sam Houston Pkwy S.
Suite 500
Houston, Texas 77099

Main: 713.686.6771
Dispatch: 713-686-6999
paradigmconsultants.com
TBPE Reg. No. F-001478

Mr. Danny Phillips, RTSBO, AIC, CPC
Executive Director of Capital Projects
Klein ISD
7520 FM 2920
Klein, TX 77379

Geotechnical Study
Schindewolf Intermediate School New Gymnasium
20903 Ella Boulevard
Spring, Texas

Mr. Phillips:

CMT Technical Services, formerly Paradigm Consultants, Inc., presents this report of our geotechnical study for the above-mentioned project. This study was authorized with a signed Professional Services Agreement on October 29, 2024. Our services were performed in general accordance with our Proposal No. 24-104, dated October 16, 2024.

Our report presents options that will affect the design, construction, performance, and cost of the structure, and involve compromises and varying levels of risk associated with movement, building distress, and other factors. These issues should be discussed with the Owner and appropriate members of the Owner's design team including the Geotechnical Engineer to help ensure that the issues and options are understood and applied in a manner commensurate with the Owner's budget, tolerance of risk, and expectations of performance and maintenance.

We appreciate the opportunity to work with you during the design phase of this project and look forward to the opportunity to provide construction materials testing and monitoring services during the construction phase. If we may be of further assistance, please call us at your convenience.

Sincerely,

Stephen Wright, E.I.T.
Graduate Engineer

Frank S. Ong, P.E.
Engineering Manager

Important Information about This

Geotechnical-Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

The Geoprofessional Business Association (GBA) has prepared this advisory to help you – assumedly a client representative – interpret and apply this geotechnical-engineering report as effectively as possible. In that way, clients can benefit from a lowered exposure to the subsurface problems that, for decades, have been a principal cause of construction delays, cost overruns, claims, and disputes. If you have questions or want more information about any of the issues discussed below, contact your GBA-member geotechnical engineer. Active involvement in the Geoprofessional Business Association exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project.

Geotechnical-Engineering Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical-engineering study conducted for a given civil engineer will not likely meet the needs of a civil-works constructor or even a different civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client. *Those who rely on a geotechnical-engineering report prepared for a different client can be seriously misled*. No one except authorized client representatives should rely on this geotechnical-engineering report without first conferring with the geotechnical engineer who prepared it. *And no one – not even you – should apply this report for any purpose or project except the one originally contemplated.*

Read this Report in Full

Costly problems have occurred because those relying on a geotechnical-engineering report did not read it *in its entirety*. Do not rely on an executive summary. Do not read selected elements only. *Read this report in full.*

You Need to Inform Your Geotechnical Engineer about Change

Your geotechnical engineer considered unique, project-specific factors when designing the study behind this report and developing the confirmation-dependent recommendations the report conveys. A few typical factors include:

- the client's goals, objectives, budget, schedule, and risk-management preferences;
- the general nature of the structure involved, its size, configuration, and performance criteria;
- the structure's location and orientation on the site; and
- other planned or existing site improvements, such as retaining walls, access roads, parking lots, and underground utilities.

Typical changes that could erode the reliability of this report include those that affect:

- the site's size or shape;
- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light-industrial plant to a refrigerated warehouse;
- the elevation, configuration, location, orientation, or weight of the proposed structure;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes – even minor ones – and request an assessment of their impact. *The geotechnical engineer who prepared this report cannot accept responsibility or liability for problems that arise because the geotechnical engineer was not informed about developments the engineer otherwise would have considered.*

This Report May Not Be Reliable

Do not rely on this report if your geotechnical engineer prepared it:

- for a different client;
- for a different project;
- for a different site (that may or may not include all or a portion of the original site); or
- before important events occurred at the site or adjacent to it; e.g., man-made events like construction or environmental remediation, or natural events like floods, droughts, earthquakes, or groundwater fluctuations.

Note, too, that it could be unwise to rely on a geotechnical-engineering report whose reliability may have been affected by the passage of time, because of factors like changed subsurface conditions; new or modified codes, standards, or regulations; or new techniques or tools. *If your geotechnical engineer has not indicated an "apply-by" date on the report, ask what it should be*, and, in general, *if you are the least bit uncertain* about the continued reliability of this report, contact your geotechnical engineer before applying it. A minor amount of additional testing or analysis – if any is required at all – could prevent major problems.

Most of the "Findings" Related in This Report Are Professional Opinions

Before construction begins, geotechnical engineers explore a site's subsurface through various sampling and testing procedures. *Geotechnical engineers can observe actual subsurface conditions only at those specific locations where sampling and testing were performed*. The data derived from that sampling and testing were reviewed by your geotechnical engineer, who then applied professional judgment to form opinions about subsurface conditions throughout the site. Actual sitewide-subsurface conditions may differ – maybe significantly – from those indicated in this report. Confront that risk by retaining your geotechnical engineer to serve on the design team from project start to project finish, so the individual can provide informed guidance quickly, whenever needed.

This Report's Recommendations Are Confirmation-Dependent

The recommendations included in this report – including any options or alternatives – are confirmation-dependent. In other words, *they are not final*, because the geotechnical engineer who developed them relied heavily on judgment and opinion to do so. Your geotechnical engineer can finalize the recommendations *only after observing actual subsurface conditions* revealed during construction. If through observation your geotechnical engineer confirms that the conditions assumed to exist actually do exist, the recommendations can be relied upon, assuming no other changes have occurred. *The geotechnical engineer who prepared this report cannot assume responsibility or liability for confirmation-dependent recommendations if you fail to retain that engineer to perform construction observation.*

This Report Could Be Misinterpreted

Other design professionals' misinterpretation of geotechnical-engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer serve as a full-time member of the design team, to:

- confer with other design-team members,
- help develop specifications,
- review pertinent elements of other design professionals' plans and specifications, and
- be on hand quickly whenever geotechnical-engineering guidance is needed.

You should also confront the risk of constructors misinterpreting this report. Do so by retaining your geotechnical engineer to participate in prebid and preconstruction conferences and to perform construction observation.

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can shift unanticipated-subsurface-conditions liability to constructors by limiting the information they provide for bid preparation. To help prevent the costly, contentious problems this practice has caused, include the complete geotechnical-engineering report, along with any attachments or appendices, with your contract documents, *but be certain to note conspicuously that you've included the material for informational purposes only*. To avoid misunderstanding, you may also want to note that "informational purposes" means constructors have no right to rely on the interpretations, opinions, conclusions, or recommendations in the report, but they may rely on the factual data relative to the specific times, locations, and depths/elevations referenced. Be certain that constructors know they may learn about specific project requirements, including options selected from the report, *only* from the design drawings and specifications. Remind constructors that they may perform their own studies if they want to, and *be sure to allow enough time* to permit them to do so. Only then might you be in a position to give constructors the information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions. Conducting prebid and preconstruction conferences can also be valuable in this respect.

Read Responsibility Provisions Closely

Some client representatives, design professionals, and constructors do not realize that geotechnical engineering is far less exact than other engineering disciplines. That lack of understanding has nurtured unrealistic expectations that have resulted in disappointments, delays, cost overruns, claims, and disputes. To confront that risk, geotechnical engineers commonly include explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely*. Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The personnel, equipment, and techniques used to perform an environmental study – e.g., a "phase-one" or "phase-two" environmental site assessment – differ significantly from those used to perform a geotechnical-engineering study. For that reason, a geotechnical-engineering report does not usually relate any environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated subsurface environmental problems have led to project failures*. If you have not yet obtained your own environmental information, ask your geotechnical consultant for risk-management guidance. As a general rule, *do not rely on an environmental report prepared for a different client, site, or project, or that is more than six months old.*

Obtain Professional Assistance to Deal with Moisture Infiltration and Mold

While your geotechnical engineer may have addressed groundwater, water infiltration, or similar issues in this report, none of the engineer's services were designed, conducted, or intended to prevent uncontrolled migration of moisture – including water vapor – from the soil through building slabs and walls and into the building interior, where it can cause mold growth and material-performance deficiencies. Accordingly, ***proper implementation of the geotechnical engineer's recommendations will not of itself be sufficient to prevent moisture infiltration.*** Confront the risk of moisture infiltration by including building-envelope or mold specialists on the design team. ***Geotechnical engineers are not building-envelope or mold specialists.***

GEOPROFESSIONAL BUSINESS ASSOCIATION

Telephone: 301/565-2733
e-mail: info@geoprofessional.org www.geoprofessional.org

TABLE OF CONTENTS

Important Information about your Geotechnical Engineering Report

EXECUTIVE SUMMARY

Klein ISD engaged CMT Technical Services (CMT), formerly Paradigm Consultants, Inc., to provide geotechnical design recommendations and construction considerations for the proposed Schindewolf Intermediate School New Gymnasium located at 20903 Ella Boulevard in Spring, Texas. This summary presents selected highlights of our findings and recommendations as a courtesy to the reader. It does not present crucial details needed for the proper application of our findings and recommendations. The findings of this study and recommendations are related through the full report only.

The subsurface soils, based on intercepted soils from our exploratory soil borings, consist of silty sand and lean clay within the 30-ft explored depth. Groundwater was not encountered during our field exploration.

The building can be supported on drilled-and-underreamed piers bearing at a depth of 11 ft below existing grade. The foundations can be sized using net allowable bearing pressures of 6.0 kips/ft^2 for total load and 4.0 kips/ft^2 for dead load plus sustained live load. A bell-to-shaft ratio of 3:1 may be considered. If a 3:1 bell-to-shaft ratio in the pier excavation is not possible due to the presence of sand/silt layer at a location during construction, a reduced bell-to-shaft ratio or straight-sided shaft with a design bell diameter will be required. We recommend test piers be drilled to determine the construction feasibility.

The clays within the anticipated zone of seasonal moisture change have plasticity indices generally ranging from 15 to 29. These soils have a medium to high shrink-swell potential with changes in moisture content. Two floor systems can be considered to address the risk and consequences of movement for the floor: a structurally supported floor slab or a slab-on-grade. To reduce potential movements of a slab-on-grade, we recommend a minimum 2 ft thick buffer of select fill be prepared beneath the slab.

INTRODUCTION

CMT Technical Services (CMT), formerly Paradigm Consultants, Inc. presents this report of our geotechnical study for the proposed Schindewolf Intermediate School New Gymnasium located at 20903 Ella Boulevard in Spring, Texas. This study was authorized with a signed Professional Services Agreement on October 29, 2024. Our services were performed in general accordance with our Proposal No. 24-104, dated October 16, 2024.

The objectives of this study were to develop design recommendations and construction considerations for foundations and subgrade preparation. Our study included the following tasks:

- Drilling and sampling 2 soil borings to explore the subsurface stratigraphy and groundwater levels;
- Geotechnical laboratory tests to aid in soil classification and determine the engineering properties of the soils encountered at the sites;
- Analysis of the field and laboratory test data to model the soil stratigraphy;
- Evaluation of the construction requirements and soil stratigraphy to develop foundation design and construction related recommendations; and
- Preparing this report presenting our findings and recommendations.

FIELD EXPLORATION AND LABORATORY TESTING

Our field exploration included drilling and sampling 2 borings. The approximate boring locations are shown on Figure 1. The borings were located in the field using the proposed development plan and existing landmarks.

Drilling Operations

Miranda Geo Drilling, a subcontractor to Paradigm, drilled and sampled soil borings on October 18, 2024, using buggy mounted drilling equipment. Paradigm's field representative was on-site to monitor drilling activities, direct the sampling efforts, and log the boreholes. Our field operations were performed in general accordance with ASTM International (ASTM D 1452[1]).

Soil Sampling

Soil was sampled continuously at 2-ft intervals to 12-ft depth with additional samples taken between 13-ft and 15-ft depths, and at 5-ft interval to the complete boring depth. The sampling method is determined based on the anticipated soils.

Soils interpreted to be cohesive soils (clay) during field operations were sampled by hydraulically pushing a 3-in. diameter, thin-walled steel tube a distance of about 24 in. Our field sampling procedures were in general accordance with ASTM D 1587.[2] For each recovered sample, our representative extruded the sample in the field, visually classified the soil, and measured the penetration resistance using a pocket penetrometer. A representative portion of the recovered sample was wrapped in aluminum foil and placed into a plastic bag for transport to our laboratory.

Water-Level Measurements

Drilling protocol includes dry augering from ground surface to the depth where water or borehole sidewall instability occurs. If neither water nor instability is encountered, dry-auger drilling techniques are used to the full depth of the boring. If water is encountered, the water level within the borehole is measured at 5-minute intervals for at least 15 minutes.

Laboratory Testing

Paradigm performed geotechnical laboratory tests in general accordance with ASTM methods on selected soil samples to aid in soil classification and determine engineering properties. The test methods performed are presented in Table 1.

Table 1: Laboratory Test Methods

Test Name	Test Method
Moisture Content	ASTM D 2216[3]
Liquid and Plastic Limits and Plasticity Index	ASTM D 4318[4]
Unconfined Compressive Strength of Cohesive Soil	ASTM D 2166[5]

Boring Logs

Paradigm's field representative logged each soil boring recording the drilling method, sampling method and interval, and penetration resistance. Details of the stratigraphic conditions encountered at each boring location were recorded on the field log in general accordance with ASTM D 5434.[6] Identification and descriptions of the soils were based on visual-manual procedures described in ASTM D 2488.[7]

The boring logs were developed using the stratigraphic and soil property data obtained during our field exploration and laboratory testing programs. Each log represents our interpretation of general soil and water conditions at the boring location. The boring logs include the type and interval depth for each sample, the corresponding penetration resistance, and the results of the index properties and strength testing. Soil classifications

were based on the Unified Soil Classification System (ASTM D 2487[8]). The boring logs and a key to the terms and symbols used on the logs are included in Appendix.

When a penetration resistance value of 4.5 tsf is recorded and penetration resistance is used to determine soil consistency, Paradigm describes consistency as very stiff to hard. In the absence of unconfined compressive strength data, Paradigm does not expressly state that soil is hard consistency. In the absence of the appropriate field and/or laboratory test data at the interval depth, no estimate of consistency or density is noted.

ASTM D 2487 classifies soil as either fine-grained or coarse-grained with the percentage of soil particles finer than the No. 200 sieve size used to differentiate between coarse-grained and fine-grained soil. Clay and silt are fine-grained soils and have 50% or more of their particles finer than the No. 200 sieve size. Gravel and sand are coarse-grained soils and have less than 50% of their particles finer than the No. 200 sieve size.

Clay has a plasticity index (PI) of 4 or greater and the plot of plasticity index versus liquid limit falls on or above the “A” line of the plasticity chart. Silt typically has a PI less than 4 and the plot of plasticity index versus liquid limit falls below the “A” line of the plasticity chart. For clay and silt, the descriptor “with sand” is used if 15% to 30% of the particles are sand size. If more than 30% of the particles within a clay or silt sample are sand size, the descriptor “sandy” is used. Fat clay has a liquid limit greater than or equal to 50, and lean clay has a liquid limit less than 50. Silty clay (CL-ML) has a PI between 4 and 7.

SURFACE AND SUBSURFACE CONDITIONS

General surface conditions were noted during our field exploration program. Subsurface conditions were evaluated by drilling 2 exploratory soil borings within the project site. Discussions of the site, subsurface and groundwater conditions encountered during our field exploration are presented in the following sections.

Surface Conditions

The site is generally level and covered with grass. Surface soils at the boring locations and along the routes taken to access the boring locations were firm.

Subsurface Conditions

The subsurface soils, based on intercepted soils from our exploratory soil borings, consist of silty sand and lean clay within the 30-ft explored depth. Additional details of encountered soils with laboratory test results are presented on boring logs in Appendix.

Groundwater was not encountered during our field exploration. Short-term water level observations should not be interpreted to represent long-term conditions. Water levels vary seasonally and with climatic conditions.

Expansiveness of Soils Encountered. The clays within the anticipated zone of seasonal moisture change, the existing ground surface to a depth of about 10 ft, have a medium to high swell/shrinkage potential (Holtz & Gibbs[9], Raman[10], and Chen[11]), as shown in Table 2. PIs for the tested clays within the upper 10-ft depth generally ranged from 15 to 29.

Table 2: Potential for Expansion

Expansion Potential	Plasticity Index Range	Liquid Limit Range
Low	**PI<18**	**----**
Medium	**15 ≤ PI ≤ 28**	**35 ≤ LL ≤ 50**
High	**25 ≤ PI ≤ 41**	**50 ≤ LL ≤ 70**
Very High	**PI > 35**	**LL > 70**

FOUNDATION RECOMMENDATIONS

The foundation system for the proposed structures must satisfy two independent engineering criteria with respect to foundation soils. First, the foundation system should be designed with an appropriate factor of safety against failure of the foundation soils. Second, the movement to the foundation system due to compression (consolidation) or expansion (swell) of the soils supporting the foundation system must be within tolerable limits for the structure. Our foundation recommendations are presented in the following report sections.

Drilled Pier Foundation Design

The proposed building can be supported on drilled pier foundation. Recommended foundation design parameters for a drilled pier foundation system are outlined in Table 3.

Table 3: Foundation Design Parameters

Parameter	Recommendation	Comments
Foundation Type	Drilled-and-Underreamed Pier	
Bearing Depth, ft	11	Below existing grade
Bearing Material	Clay	
Net Allowable Bearing Pressure*, q_{all}		
Total Load, kips/ft^2	6.0	Includes factor of safety (F.S.) of 2
Dead Load plus Sustained Live Load, kips/ft^2	4.0	Includes factor of safety (F.S.) of 3
Lateral Resistance, $q_{lateral}$, kips/ft^2	1.0	Includes F.S. of 3; neglect upper 5 ft
Pier (Footing) Spacing	At least two underream or shaft diameters; whichever is greater	Measured center-to-center
Bell to Shaft Ratio	3:1	2:1 or Straight-sided if sloughing is encountered
Pier Reinforcement	Minimum of 0.5% to 1% of concrete area	Extend the full depth of shaft and underream

Notes: * May be increased 33% for transient loading conditions such as wind.

A bell-to-shaft ratio of 3:1 may be considered. If a 3:1 bell-to-shaft ratio in the pier excavation is not possible due to the presence of sand/silt layer at a location during construction, a reduced bell-to-shaft ratio or straight-sided shaft with a design bell diameter will be required.

Drilled Pier Foundation Installation

Installation considerations include test pier, water conditions, reinforcing and concrete placement, and monitoring. These topics are discussed in the following sections.

Test Pier. We recommend test piers be drilled to verify the construction feasibility of drilled-and-underreamed piers, as planned. Test piers provide beneficial information for the contractor about cleaning, sloughing, and water conditions. Installation of underreamed piers may proceed provided the bearing surface is clean before concrete placement. If test piers are drilled, at least two piers should be installed across the site. The geotechnical engineer or his qualified representative should observe test pier installation.

Test piers should be drilled with the largest diameter shaft and bell with the largest bell to shaft ratio proposed for the project. The piers should extend to the recommended bearing elevation. Piers should be located within the footprint of the building but should not be located at working pier locations. Test piers may be backfilled with concrete, cement-stabilized sand, or flowable fill. Cement stabilized sand should meet a specification similar to Item 400 of TxDOT *Standard Specifications for Construction of Highways, Streets and Bridges.*[12] Flowable fill should meet a specification similar to Item 434 of *Specifications for the Construction of Roads and Bridges within Harris County*.[13] Excavated soil should not be used to backfill test piers. For planning purposes, test piers should remain open for 2 hr to evaluate sidewall stability. Production drilling may proceed immediately after test pier installation provided no difficulty is encountered during test pier installation.

Water Conditions. Based upon the observations during the field exploration, seepage into drilled-and-underreamed piers may not be anticipated during the excavation. If water in excess of about 2 in. accumulates at the bottom of the excavation, the water should be pumped out before concrete placement. Water levels vary seasonally and with climatic conditions. Therefore, the contractor should verify that groundwater will not adversely affect pier installation prior to foundation construction.

Reinforcing and Concrete Placement. Reinforcing steel should be clean and free of any bond-inhibiting coating or mud. Reinforcing steel should be properly positioned and supported to assure the design concrete cover around the reinforcing steel is achieved. Before concrete placement, the bottom of each excavation should be cleaned. If water in excess of about 2 in. accumulates at the bottom of the excavation, the water should be pumped out before concrete placement.

Concrete should be placed in pier excavations within 2 hr after excavation to reduce the potential for soil sloughing and/or perched water seepage from the excavation walls. If sloughing soils are encountered in the excavation, it may be necessary to place reinforcing steel and concrete immediately after completion of excavation. Concrete should conform to applicable requirements of ACI 301,[14] ACI 318,[15] and ASTM C 94/C 94M.[16] The concrete slump should be 5 in. ± 1 in. Concrete should be placed with a tremie to direct the concrete toward the bottom of the foundation excavation. The concrete should not be allowed to ricochet off the walls of the excavation or the reinforcing steel. Pier design and placement should comply with the requirements of ACI 318, ACI 336.3R[17] and ACI 336.1.[18]

Monitoring. Depth to competent bearing soils is based on conditions encountered at the boring locations. Significant variations can occur over short horizontal distances from the boring locations. Our representative should be present during foundation construction to verify that the proper bearing stratum has been reached, the pier dimensions are as designed, the reinforcing steel is as specified, and that the excavation is clean and dry before reinforcing and concrete placement.

FLOOR SLAB SYSTEM

The in-situ clays encountered during our field exploration program generally have a medium to high shrink/swell potential with soil moisture changes. A range of options from structurally-isolated floor slab to slab-on-grade may be considered for floor slab design. The selection of a specific option depends on risk of movement and consequential damage to the structure.

Structurally Isolated Floor Slab

The use of a structurally isolated floor slab with crawl space or void form is the most effective method to avoid the effects of moisture-related soil movement. A structurally supported floor should be selected if equipment installed on the first floor or if building elements or finishes on the first floor will be sensitive to movement. If the potential for slab movement must be eliminated, we recommend the structural slab. Void forms should be used to provide at least 6-in. void beneath the slab to accommodate swelling movement of the subgrade soils. The building subgrade for a structurally isolated floor slab, if selected, should be prepared to provide a level and firm surface for placement of the collapsible void forms.

Slab-on-Grade

To reduce potential movements of a slab-on-grade, we recommend a minimum 2 ft thick buffer of select fill be prepared beneath the slab. The subgrade to a depth of at least 8 in. should be moisture conditioned prior to placement of 2-ft thick select fill pad. Earth work should extend at least 5 ft beyond the limits of the building footprint to assure the edges are sufficiently prepared. The slab should be elevated a minimum 12-in. above the surrounding grade to encourage runoff water to flow away from the slab. Recommendations for subgrade

preparation, select fill soils, and moisture conditioning of natural soils are presented in the *Site Development Considerations* section of this report.

The near-surface soil consists of silty sands underlain by moderate to high plasticity clays. These sands are permeable and may create a perched water condition. These sands can provide a pathway for water to travel underneath the slab resulting in swelling of the subsoils. It is recommended that surficial sands be removed and replaced with select fill.

Grade Beams. Grade beams can be used to stiffen the floor slab. The depth of exterior and interior grade beams can be varied according to the structural requirements of the floor slab. We recommend the depth of the exterior grade beams be at least 2.5-ft below the lowest adjacent grade. We do not recommend the use of void boxes below grade beams because of the potential to collect free water within the void space.

Finished Grade Conditions. Slab-on-grade construction should proceed as soon as possible after completion of the building pads to prevent changes in the density and moisture conditions of the building pad soils. If construction is delayed and the fill soils are exposed to inclement weather or traffic, recompaction or moisture adjustment of the pad to at least 6-in. depth may be needed to return the soils to the specified density and moisture range. Alternately, protection of the fill soils with plastic sheeting or the placement of a protective fill layer may be considered. The plastic sheeting or protective fill layer must be removed before slab construction. The final lift should be moisture adjusted and recompacted before the floor slab is placed. Construction should not proceed on dry or saturated subgrade.

Leveling Course. A leveling course, typically bank sand, is commonly used beneath floor slabs in the Gulf Coast area. Because of the potential for a granular course to act as a conduit for water, we recommend that the leveling course be limited to about 2-in. thickness or eliminated.

Vapor Retarder. ACI 302.1R, Guide for Concrete Floor and Slab Construction[19] recommends that a vapor retarder with a permeance of less than 0.3 US perms (ASTM E 96[20]). The thickness of the vapor retarder should not be less than 10 mils, placed under the concrete floor slab on ground to reduce the transmission of water vapor from the supporting soil through the concrete slab. The vapor retarder should function as a slip-sheet to reduce subgrade drag friction. Local practice is to place the concrete floor directly on the vapor retarder. The vapor retarder should be installed according to ASTM E 1643[21]. Water that collects within the building pad area after the vapor retarder is placed should be removed before concrete placement.

Utility Bedding and Backfill. Cement-stabilized sand is a preferred bedding material for utilities within the limits of the building and paving. Cement stabilized sand should meet the requirements of Item 400.3 of the TxDOT Specifications (Cement Stabilized Backfill[22]), or equivalent. Backfill for utility trenches within and for a distance of 10 ft from the building

footprint should be select structural fill or cement-stabilized sand. Material and placement criteria for structural fill were presented in the *Building Pad Preparation* section. A testing frequency of one in-place density and moisture test for each 75 linear feet of utility trench or a minimum of two tests per lift should be included in the project specifications.

A bentonite seal should be placed within utility trenches where the trenches exit the building footprint. The seals should be located within 5-ft of the building and should be at least 2-ft in length; bentonite should not be placed under grade beams. The bentonite seal will prevent water infiltration into the utility bedding and backfill.

Slab Performance

Throughout much of the State, buildings supported on pier foundations use a slab-on-grade supported on a constructed building pad of relatively low-plasticity fill. This system is widely used and generally provides Owners with years, if not a lifetime, of acceptable performance. Nevertheless, a slab-on-grade presents a risk of poor long-term building performance.

The practice of most geotechnical engineers is to provide at least two options for the floor slab system: 1) a structural slab elevated above the site grade and supported by a deeper foundation system, and 2) a slab-on-grade. These two systems will not provide comparable assurance of performance. The structural slab relies on support by the foundations, typically piers that are placed at a sufficient depth to greatly reduce the risk of movement due to most causes of moisture fluctuation. A slab-on-grade, however, is susceptible to the inherent instability of the supporting clay subgrade, including any clay fill that will shrink or swell with any moisture fluctuation whether it occurs during or following construction.

Thus, the selection of the floor slab system should be made by the Owner with the counsel of the design and construction team to adequately advise the Owner of the risks each system presents and the relative costs. Owners select the least expensive system only to discover later that the performance of the system does not meet their expectations. This discussion is intended to assist the Owner in that decision.

Design methods for slab-on-grade construction consider only climatic factors and are based on average climatic conditions being present before construction and throughout the structure life. Maintaining balanced soil moisture conditions in the subgrade throughout the structure life reduces the potential for differential movements. Early in the life of the structure, the performance of a slab-on-grade will be affected by the soil moisture conditions at the time of construction, and they may be different than the conditions that existed during the geotechnical study. The conditions will be affected by the weather before and during construction, construction techniques, and site preparation including drainage. Steps should be taken to reduce moisture content fluctuations within the near-surface soils. Positive drainage to carry runoff away from the structure will minimize excess migration into the soils. Following construction, Owner influences begin to control soil moisture and the potential for soil movement. Rainfall, drainage, irrigation, or unintended water sources such as broken or

leaking irrigation or utility lines can disrupt the post-construction moisture conditions and cause soils to swell. Landscaping, particularly trees, and dry weather can cause shrinkage of the clays and settlement.

The amount of movement considered acceptable to many Owners is less than that tolerated by the structural members. Movements often result in cracks in brick or masonry veneer or walls; cracks in drywall; separation of the joints in trim; cracks in tile floors, walls, and countertops; and distortion to windows and doors making them difficult to open and close. While these consequences of movement are annoying and may be unsightly, they do not necessarily indicate unacceptable structural performance or failure. Movements sufficient to cause those types of distress should be anticipated if a slab-on-grade floor slab is constructed on active clay soils.

Climatic Factors. Average annual climatic conditions are documented in the area, but these conditions occur in cycles of dry weather followed by wet weather. Such cycles coupled with the time of construction have a significant influence on the long-term performance of the structure. If construction proceeds during or immediately after a dry period, the soils within the upper 5 ft to 10-ft depth are expected to be dry. When moisture is introduced, such as, through infiltration of rainfall along the slab edges, the dry soils likely will swell. Conversely, if construction proceeds after a wet period, the soils likely are wet and have experienced some swell. Although additional swell may occur, the amount of swell likely will be less than that experienced by dry soils. Shrinkage of wet soils likely will occur during dry periods.

Non-Climatic Factors. Factors unrelated to climate may result in soil movements that may be greater than those resulting only from climatic influences. The presence of many non-climatic factors is generally beyond the direct influence of the design team and is often manifested during the structure life. Non-climatic factors that affect the moisture content of the site soils include the presence of trees (existing and recently removed) and landscaping, inadequate drainage or altered drainage during the structure life, and the availability of moisture from unplanned sources such as roof drains, air conditioning drains, or below-grade utility or irrigation system leaks. Design methods cannot account for movements resulting from these non-climatic factors. Since the slab performance is related to soil properties, climatic factors, non-climatic factors, and the interaction between factors that may occur during the structure life, the actual amount of movement that can be expected over the life of the structure cannot be quantified. Non-climatic factors and their potential effects on structure performance are discussed in the following paragraphs.

Drainage. Improper drainage can have significant negative effects on the performance, especially if the structure were constructed during or immediately after a dry period. The following are general notes concerning proper drainage considerations:

- Positive drainage away from the structure must be designed, constructed, and maintained throughout the structure life.

- Landscaping systems must maintain the positive drainage away from the structure and not permit water to impound adjacent to the structure.

- Downspouts from roof drainage systems and air conditioning unit drains should be designed to discharge water away from, and preferably 10-ft or more from, the foundation.

- Drainage through drainpipes to the storm sewer is preferred for all roof drains.

- Splash blocks are not effective in draining water away from the foundation and should not be used.

- Water drains should be tied to the storm sewer and not be allowed to drain along the boundary of the building with discharge at the foundation.

Unplanned Water Sources. Following the effects of landscaping and improper drainage, unplanned water releases such as from poorly constructed or broken below-grade utility lines, pool leaks, irrigation system leaks, or other unintended or unanticipated water sources are the most prevalent causes of poor foundation and slab-on-grade performance. The sources may be particularly problematic because they often go unnoticed for weeks or months causing significant movement of the soils and significant distress to the structure. Again, design methods do not account for soils movements resulting from these non-climatic factors.

Summary. Based on our experience, a slab-on-grade is selected for well over 95% of light loaded structures. Few problems may develop when subgrade moisture conditions are affected only by climatic factors. However, where non-climatic factors over which the design team has little or no control are allowed to influence the subgrade moisture variations, the result is frequently unsatisfactory foundation performance. Therefore, the selection of a slab-on-grade carries a substantially greater risk than a structurally-isolated floor slab. The Owner should understand that with the selection of a slab-on-grade, they must accept the associated risks and consequences.

CONNECTION TO EXISTING STRUCTURE

There are several issues that must be considered for the proposed building expansion: the flexibility of connecting a new structure to an existing structure and the potential of interfering with an existing footing. It is recommended that the new structure not be structurally connected to the existing structure.

The existing structure has been in place for a period sufficient to have allowed the structure to settle under its own weight. The soil supporting the new structure will undergo immediate or short-term settlement in response to the weight of the building. For this reason, all hard connections and brittle floor or wall coverings that will cross or span over the area between the existing building and the new structure should be made as late in the construction process as practical. This will allow relative movement to occur before making connections.

It is recommended that the type, location, and depth of the existing foundation system should be determined from as-built drawings of the original construction or verified in the field. New foundations should be placed at the same or similar depth as the existing foundations to help reduce the effects of stress interaction below the foundations. The new foundations should be located about two footing dimensions apart or a 15 ft clear distance from an existing foundation to reduce pressure interaction in the soils below the old and new foundations. If this dimension is not acceptable, then CMT should be contacted to provide a bearing capacity reduction accommodate the stress and control settlement. This distance will also help to reduce the chance of undermining the existing foundation during construction. When excavating or digging for any reason next to the existing structure care must be exercised by the constructor so that the existing foundation and structure are not undermined.

If the existing building foundations are found to be different than those recommendations for the new foundations, CMT should be contacted and engaged to provide additional recommendations.

EXTERIOR SIDEWALKS, PATIOS, AND SURFACE PAVING

Lightly-loaded exterior sidewalks, patios, and similar concrete surface paving are very susceptible to movement when supported on an expansive subgrade. If surface paving is adjacent to building slabs, differential movement may occur between the exterior concrete paving and building slabs creating problems such as binding of outward-swinging doors and trip hazards. If surface paving is attached to the building, differential movement may cause the surface paving to move upward more that the building slab and cause reverse drainage toward the buildings.

We recommend that consideration be given to stabilizing the subgrade soils supporting sidewalks, patios and, surface paving abutting the slab in a manner similar to that for vehicular pavements or by extending the low-expansion buffer beyond the building limits to support the exterior concrete to reduce differential movement between the slab (or grade beam) and abutting exterior concrete. The buffer should extend at least 5-ft beyond the limits of the exterior concrete.

SITE DEVELOPMENT CONSIDERATIONS

To plan the construction, initial earthwork will include wet weather site condition, site drainage, clearing, stripping, proofrolling, and select fill placement and testing. Recommendations for each of these preparation items are presented in the following sections. Material specifications and placement criteria for select fill soils are also provided.

Wet Weather Site Conditions

The surficial soils are very sensitive to changes in soil moisture. The surface soils consist of silty sands underlain by moderate to high plasticity clays. These sands are permeable and may create a perched water condition. If construction is initiated in the dry weather, these soils can become dry and hard. If construction is initiated just after or during a rainy season or rain events, then the surf soil can become wet and weak, unable to support construction equipment in some circumstances. There are several options that can be taken to resolve this issue:

1. Remove the wet, weak soil and replace with select fill, properly compacted, or

2. Wait until the weather dries the soil and then begin or resume construction. Tilling will help expedite the drying process only if additional rain does not occur before the soil is compacted, or

3. Use chemical additives such a lime/fly ash blend to dry the soil as well as bind the soil particles together.

If this situation of wet, weak soil due to rain and poor drainage occur, the contractor should be prepared to use an appropriate procedure to complete construction. It is suggested that one or all of these methods be placed in the bid documents so that there will be a bid item on which to base an economic judgment of the solution to fit the goals of the owner.

Site Drainage

Based on our experience with similar projects, drainage should be established early in the site development and maintained as the site grades change. Drainage could be critical if construction begins following or during a period of wet weather.

Stripping

The exposed soils within and 5-ft beyond the proposed building areas should be stripped of vegetation, topsoil, debris, and other deleterious materials. For planning purposes, we recommend a stripping depth of at least 6 in. Stripped soils should not be used as select fill but may be suitable for landscaping purposes.

Proofrolling

Proofrolling is a method to evaluate the performance of the surface soils within 18-in. under load application. Proofrolling should be performed in building and paving areas using a heavy rubber-tired vehicle such as loaded dump truck, a large maintainer or pneumatic equipment weighing about 20 tons. Proofrolling operations should be observed by our representative to delineate areas that require remediation. Remediation typically involves removing and replacing the soft areas; disking, drying and recompacting the soils; or treating the soils with a chemical additive.

Moisture Conditioning

The building pad subgrade should be moisture conditioned and recompacted prior to placement select fill pad. Moisture conditioning should be performed to bring the *in-situ* moisture content of the subgrade to within 0 to 4% wet of optimum moisture content. Moisture conditioning of the subgrade (8 in.) can be accomplished by controlled sprinkling of water on the natural lean clay soils and compacting to at least 95 percent of the maximum dry density, as determined by ASTM D 698 (Standard Proctor) prior to placement of successive lifts. Maintaining constant moisture content within the *in-situ* soils both pre- and post-construction is important to the successful performance of the slab-on-grade foundation.

Select Fill Placement and Testing

Select fill for the building pad should consist of lean clay, free of roots, organics, and deleterious materials. The select fill should have at least 50% passing the No. 200 sieve and have a PI between 12 and 20, with a liquid limit less than 35. Representative samples of the fill materials should be tested to confirm their material characteristics.

Select fill should be placed in maximum 8-in. thick loose lifts and compacted to 95% of the maximum dry density (ASTM D 698). Over-compaction should be avoided. The moisture contents for select fill should be within 1% dry to 3% wet of the optimum moisture content. Fill placement greater than one 6-in. thick compacted lift should be tested and documented by the geotechnical engineer or an experienced soils technician. A testing frequency of one in-place density and moisture test for each 2,500 ft^2 or less per lift of fill should be considered, with a minimum of two tests per lift.

CONSTRUCTION OBSERVATION

As dictated by common practice, our geotechnical engineering analysis and recommendations are based on the information on the subsurface conditions obtained from small diameter, widely-spaced borings and our judgment based on our education and experience. Because the borings indicate subsurface conditions only at the specific locations and time and only to the depths penetrated, they do not necessarily reflect strata variations that may exist between boring locations. Therefore, the validity of the recommendations in this report is based in part on assumptions about the stratigraphy made

by the geotechnical engineer. Because variations may not be evident until construction begins, Paradigm should be retained to observe foundation installation and perform construction materials monitoring and test, particularly earthwork construction, during the construction phase of the project.

Our involvement enables Paradigm's geotechnical engineer or his/her representative to monitor the foundation and earthwork activities and be available to personally evaluate unanticipated conditions, conduct additional tests, if necessary, and to provide alternative recommendations where appropriate. Therefore, our recommendations on issues such as final bearing elevation, depth of undercutting unsuitable materials, and appropriateness of subgrade stabilization agent and quantity should be considered preliminary until actual subsurface conditions are revealed during construction.

LIMITATIONS

Opinions, conclusions, and recommendations presented in this geotechnical engineering report are based on the data obtained from the field and laboratory programs, our interpretation of the data, and information received from our client and construction professionals associated with the project. If changes in the nature, design, or location of the project are made, the opinions, conclusions, and recommendations contained in this report are not valid unless the changes are reviewed by Paradigm and the recommendations included within this report are modified or verified in writing by Paradigm. If subsurface conditions different from those described are noted during construction, recommendations in this report must be reevaluated.

The scope of our services did not include environmental assessment, compliance with applicable laws, geologic faults, and wetlands. Our scope did not include the investigation, detection, or design related to the presence of any biological pollutants. The term "biological pollutants" include, and is not limited to, mold, fungi, spores, bacteria, and viruses, and the byproducts of any such biological organisms.

Design Review

Paradigm should review the design drawings and specifications before being released for construction. Our review will confirm that the geotechnical recommendations and construction criteria presented in this report have been correctly interpreted and implemented. Paradigm is not responsible for any claims, damages, or liability associated with non-compliance with or misinterpretation of the recommendations and construction criteria presented in our geotechnical report. Design review is not within the scope of services authorized in this study. We would be pleased to submit a budget for this activity.

Standard of Care

This study was performed in a manner consistent with the level of care and skill ordinarily exercised by reputable geotechnical engineers practicing contemporaneously in the local area. No warranty or guarantee, express or implied, is made or intended.

Report Reproduction

Paradigm's report was prepared exclusively for Klein Independent School District and its project team for use in preparing design and construction documents. This report shall not be reproduced or used for any other purpose without Paradigm's express written authorization. If included in construction documents, the report should be provided in its entirety with the caveat that it is included as a construction reference. Specific project requirements including options selected from this report must be obtained from the design drawings and specifications.

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21. ASTM E 1643-11 “Practice for Installation of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs,“ *Annual Book of ASTM Standards,* Part 04.11, ASTM, West Conshohocken, PA.

22. TxDOT Item 400.3, "Cement Stabilized Backfill," *Standard Specification for Construction and Maintenance of the Highways, Streets and Bridges*, Texas Department of Transportation, Austin, TX, November 2014.

Reference: Base map provided by client
Note: Boring locations are approximate
Legend: ⌖ Boring location

Schindewolf Intermediate School - New Gymnasium 20903 Ella Blvd Spring, TX	**CMT Technical Services** 9980 West Sam Houston Parkway South, Suite 500 Houston, Texas 77099
Klein ISD Klein, TX	Project No. 24-1062 FIGURE 1 PLAN OF BORINGS

Appendix

SOIL BORING LOGS

LOG OF BORINGS

Project: Schindewolf Intermediate School - New Gymnasium
20903 Ella Blvd
Spring, TX
Client: Klein ISD
Klein, TX

Project No.: 24-1062
Boring Number: B-1
Surface Elevation:
Drilled: 10/19/24 - 10/19/24
Sheet 1 of 1

Drilling Method(s):
Dry-auger drilling: 0 ft to 30 ft

Borehole Water Levels:
First encountered N/A

Depth, ft	Soil Symbol	Sample Interval, Sampler Type	Penetration Resistance, P, tsf Standard Penetration Test N, blows/ft or blows/interval	Moisture Content, %	Finer than No. 200 sieve, %	ATTERBERG LIMITS Liquid Limit LL	Plastic Limit PL	Plasticity Index PI	Dry Density, lb/ft³	Undrained Shear Strength, c_u, lb/ft²	Failure Strain, %	Confining Pressure, lb/in²	Comment	DESCRIPTION OF STRATUM
				7.5										SILTY SAND (SM): Brown.
			P = 2.25	13.9		15	12	3	114	770	4.37		Vertical Fracture	LEAN CLAY (CL): Very stiff to hard, brown.
														- with silt layer, 2 to 4 ft.
5			P = 3.5	12.6										
			P = 4.5	15.5		36	13	23						- with ferrous nodules, 6 to 16 ft.
			P = 4.5+	15.0										
10			P = 4.5+	17.0										
			P = 4.5	13.9					122	3740	11.39		Bulge, Single Shear	
15														
														- reddish brown below 18 ft.
			P = 4.5+	13.7										
20														
			P = 4.5+	13.8										
25														
			P = 4.5	14.9										
30														

Remarks:

Borehole terminated at 30-ft depth

03GEOTECH1 24-1062 BORING LOGS.GPJ HARRIS COUNTY FLOOD CONTROL DISTRICT TEMPLATE - UPDATED.GDT 11/4/24

LOG OF BORINGS

Project: Schindewolf Intermediate School - New Gymnasium
20903 Ella Blvd
Spring, TX
Client: Klein ISD
Klein, TX

Project No.: 24-1062
Boring Number: B-2
Surface Elevation:
Drilled: 10/19/24 - 10/19/24
Sheet 1 of 1

Drilling Method(s):
Dry-auger drilling: 0 ft to 30 ft

Borehole Water Levels:
First encountered N/A

Depth, ft	Soil Symbol	Sample Interval, Sampler Type	Penetration Resistance, P, tsf Standard Penetration Test N, blows/ft or blows/interval	Moisture Content, %	Finer than No. 200 sieve, %	ATTERBERG LIMITS Liquid Limit LL	Plastic Limit PL	Plasticity Index PI	Dry Density, lb/ft³	Undrained Shear Strength, c_u, lb/ft²	Failure Strain, %	Confining Pressure, lb/in²	Comment	DESCRIPTION OF STRATUM
				6.9										SILTY SAND (SM): Brown.
			P = 2.0	14.1										LEAN CLAY (CL): Stiff to hard, brown.
														- with ferrous stains, 2 to 6 ft.
5			P = 1.5	14.1		28	13	15						
			P = 3.0	14.1										
			P = 4.25	14.2		41	12	29	121	1150	4.28		Multiple Shear, Vertical Fracture	
10			P = 3.25	20.2					110	2800	9.40		Bulge, Multiple Shear	
			P = 3.5	14.7										- light gray below 13 ft.
15														
			P = 4.25	14.6										
20														
			P = 3.5	14.2										
25														
			P = 3.75	24.7										- reddish brown below 28 ft.
30														

Remarks:

Borehole terminated at 30-ft depth

KEY TO BORING LOG TERMS AND SYMBOLS

MATERIAL SYMBOLS


Fat Clay (CH)


Lean Clay (CL)


Sandy Lean Clay (CL)


Silty Clay (CL-ML)


Silt (ML)


Sandy Silt (ML)


Elastic Silt (MH)


Organic Clay or Silt (OH) High Plasticity


Organic Clay or Silt (OL) Low Plasticity


Peat (PT)


Well Graded Sand (SW)


Poorly Graded Sand (SP)


Silty Sand (SM)


Clayey Sand (SC)


Well Graded Gravel (GW)


Poorly Graded Gravel (GP)


Silty Gravel (GM)


Clayey Gravel (GC)


Fill


Asphalt


Base


Concrete

SAMPLER SYMBOLS


Auger


Thin-walled tube


Split barrel


Core


No recovery

STANDARD PENETRATION TEST (SPT)

N = 25	The sampler was seated 6 in. with blows from a 140-lb hammer then 25 blows were required to advance the sampler through the two 6-in. intervals of the test. The "N" value is the sum of the blows needed to penetrate the final 12 in.
12, 26, 50/3"	The sampler was seated 6 in. by 12 blows from a 140-lb hammer then 76 blows were required to advance the sampler a distance of 9 in. Full penetration of 12 in. below the seating interval could not be achieved before the 50 blow limit was recorded in one interval.
50/4"	Sampler was driven 4 in. of the 6-in. seating interval by blows of a 140-lb hammer before the 50 blow limit was reached.

WATER SYMBOLS


Depth where water was first encountered during drilling

Depth where water was encountered within the open borehole after completion of drilling (see log for elapsed time)

DESCRIPTIVE TERMS

Fine-Grained
(Major portion passing No. 200 sieve)
Silt and Clay

Consistency	Undrained Shear Strength, ksf	SPT "N" Value
Very soft	Less than 0.25	Less than 2
Soft	0.25 to 0.50	2 to 4
Firm	0.50 to 1.00	4 to 8
Stiff	1.00 to 2.00	9 to 15
Very stiff	2.00 to 4.00	15 to 30
Hard	Greater than 4.00	Greater than 31

Coarse-Grained
(Major portion retained on No. 200 sieve)
Gravel and Sand

Description	Relative Density	SPT "N" Value
Very loose	0 to 15%	Less than 4
Loose	15% to 35%	4 to 10
Medium dense	35% to 65%	10 to 30
Dense	65% to 85%	30 to 50
Very dense	85% to 100%	Greater than 50

PCI's geotechnical engineer reviewed and compiled the field and laboratory data to develop each boring log. Each log represents our interpretation of general soil and water conditions at the boring location. Strata lines on the log may be transitional and are approximate in nature. Water levels refer only to those conditions observed at the time and location indicated.

DOCUMENT 004113 - BID FORM - STIPULATED SUM (SINGLE-PRIME CONTRACT)

1.1 BID INFORMATION

A. Bidder: _____.

B. Project Name: Klein Independent School District. Schindewolf Gym Addition.

C. Project Location: 20903 Ella Blvd, Spring, Texas 77388.

D. Owner: Klein Independent School District, 7200 Spring Cypress Road, Klein, Texas 77379.

E. Architect: DLR Group inc of Texas, a Texas Corporation.

F. Architect’s Project Number: 39-25107-00.

1.2 CERTIFICATIONS AND BASE BID

A. Base Bid, Single-Prime (All Trades) Contract: The undersigned Bidder, having carefully examined the Procurement and Contracting Requirements, Conditions of the Contract, Drawings, Specifications, and all subsequent Addenda, as prepared by DLR Group and Architect's consultants, having visited the site, and being familiar with all conditions and requirements of the Work, hereby agrees to furnish all material, labor, equipment and services, including all scheduled allowances indicated in Section 012100 "Allowances, necessary to complete the construction of the above-named Project, in accordance with the requirements of the Procurement and Contracting Documents, for the stipulated sum of:

1. _____ Dollars ($_____).
2. Amounts shall be shown in both words and figures. In case of discrepancy, the amount shown in words will govern.
3. The above amount may be modified by amounts indicated by the Bidder under the "Alternates" Article below.

1.3 ALTERNATES

A. The undersigned Bidder proposes the amount below be added to or deducted from the Base Bid if particular Alternates are accepted by Owner. Amounts listed for each Alternate include costs of related coordination, modification, or adjustment. Amounts shall be shown in both words and figures. In case of discrepancy, the amount shown in words will govern.

B. If the Alternate does not affect the Contract Sum, the Bidder to indicate "NO CHANGE."

C. If the Alternate does not affect the Work of this Contract, the Bidder to indicate "NOT APPLICABLE."

D. The Bidder is responsible for determining from the Contract Documents the effects of each Alternate on the Contract Time and the Contract Sum.

E. Owner reserves the right to accept or reject any Alternate, in any order, and to award or amend the Contract accordingly within 60 days of the Notice of Award unless otherwise indicated in the Contract Documents.

F. Acceptance or non-acceptance of any Alternates by Owner is to have no effect on the Contract Time unless the Alternate description below provides a formatted space for the adjustment of the Contract Time.

G. Alternate No. 1A: Resilient Athletic Flooring, Class 2 Shock Absorption Product:

1. ☐ ADD ☐ DEDUCT ☐ NO CHANGE ☐ NOT APPLICABLE.

2. _____ Dollars ($_____).

H. Alternate No. 1B: Resilient Athletic Flooring (Comparable Tarkett Product):

1. ☐ ADD ☐ DEDUCT ☐ NO CHANGE ☐ NOT APPLICABLE.

2. _____ Dollars ($_____).

I. Alternate No. 2: Marquee Sign.

1. 2A, LED Partners:

a. ☐ ADD ☐ NO CHANGE ☐ NOT APPLICABLE.

b. _____Dollars ($_____).

2. 2B, Daktronics:

a. ☐ ADD ☐ NO CHANGE ☐ NOT APPLICABLE.

b. _____Dollars ($_____)

3. 2C, Spectrum - Watchfire:

a. ☐ ADD ☐ NO CHANGE ☐ NOT APPLICABLE.

b. _____Dollars ($_____)

J. Alternate No. 3: Chiller:

1. 3A, Daikin:

a. ☐ ADD ☐ NO CHANGE ☐ NOT APPLICABLE.

b. _____Dollars ($_____).

2. 3B, Trane:

a. ☐ ADD ☐ NO CHANGE ☐ NOT APPLICABLE.

b. _____Dollars ($_____)

3. 3C, Carrier:

a. ☐ ADD ☐ NO CHANGE ☐ NOT APPLICABLE.

b. _____Dollars ($_____)

K. Alternate No. 4: Campus Communication System:

1. ☐ ADD ☐ NO CHANGE ☐ NOT APPLICABLE.

2. _____ Dollars ($_____).

L. Alternate No. 7: Fire Alarm:

1. 7A, Edwards System Technology (EST 4) by Wilson Fire

a. ☐ ADD ☐ NO CHANGE ☐ NOT APPLICABLE.

b. _____Dollars ($_____).

2. 7B, Siemens by Fire-Safe:

a. ☐ ADD ☐ NO CHANGE ☐ NOT APPLICABLE.

b. _____Dollars ($_____)

3. 7C, Notifier by Fire-Tron:

a. ☐ ADD ☐ NO CHANGE ☐ NOT APPLICABLE.

b. _____Dollars ($_____)

1.4 BID SECURITY

A. The undersigned Bidder agrees to execute a contract for this Work in the above amount and to furnish surety as specified within 10 days after a written Notice of Award, if offered within 60 days after receipt of bids, and on failure to do so agrees to forfeit to Owner the attached Bid Security, as liquidated damages for such failure as follows:

1. In the following amount constituting 10 percent of the Base Bid amount above:

a. _____ Dollars ($_____).

B. Form of Bid Security: Bidder has attached the following:

1. ☐ AIA Document A310-2010, "Bid Bond."
2. ☐ Cashier's check.
3. ☐ Certified check.

C. In the event Owner does not offer Notice of Award within the time limits stated above, Owner will return to the undersigned the cashier's check, certified check, or bid bond.

1.5 SUBCONTRACTORS AND SUPPLIERS

A. The following companies to execute subcontracts for the portions of the Work indicated:

1. Masonry Work: _____.
2. Roofing Work: _____.
3. HVAC Work: _____.
4. Electrical Work: _____.

1.6 TIME OF COMPLETION

A. Time of Completion:

1. The undersigned Bidder proposes and agrees hereby to commence the Work of the Contract Documents on a date specified in a written Notice to Proceed to be issued by Architect, and to substantially complete the Work on or before March 25, 2026.

1.7 ACKNOWLEDGMENT OF ADDENDA

A. The undersigned Bidder acknowledges receipt of and use of the following Addenda in the preparation of this Bid:

1. Addendum No. 1, dated _____.
2. Addendum No. 2, dated _____.
3. Addendum No. 3, dated _____.
4. Addendum No. 4, dated _____.

1.8 CONTRACTOR'S LICENSE

A. The undersigned further states that it is a duly licensed contractor, for the type of work proposed, in the Project’s jurisdiction, and that all fees, permits, etc., pursuant to submitting this proposal have been paid in full.

1.9 SUBMISSION OF BID

A. Respectfully submitted this ____ day of _____ (Insert month and year).

B. Submitted by: _____ (Name of bidding firm or corporation).

C. Authorized Signature: _____ (Handwritten signature).

D. Signed by: _____ (Type or print name).

E. Title: _____ (Owner/Partner/President/Vice President).

F. Witnessed by: _____ (Handwritten signature).

G. Attest: _____ (Handwritten signature).

H. By: _____ (Type or print name).

I. Attester Title: _____ (Corporate Secretary or Assistant Secretary).

J. Street Address: _____.

K. City, State, Zip: _____.

L. Phone: _____.

M. License No.: _____.

N. Federal ID No.: _____.

(Affix Corporate Seal Here)

END OF DOCUMENT 004113

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DOCUMENT 006000 - PROJECT FORMS

1.1 FORM OF AGREEMENT AND GENERAL CONDITIONS

A. The following form of Owner/Contractor Agreement and form of the General Conditions to be used for Project:

1. AIA Document A101-2017 "Standard Form of Agreement between Owner and Contractor Where the Basis of Payment is a Stipulated Sum."

    a. The General Conditions for Project are AIA Document A201-2017 "General Conditions of the Contract for Construction."

2. The General Conditions are incorporated by reference.
3. The Supplementary Conditions for Project are separately prepared and included in the Project Manual. Refer to Section “007300 “General and Supplementary Conditions of the Contract for Construction.”

1.2 ADMINISTRATIVE FORMS

A. Administrative Forms: Additional administrative forms are specified in Division 01 General Requirements.

B. Copies of AIA standard forms may be obtained from AIA Contract Documents: https://aiacontracts.com.

C. Preconstruction Forms:

1. Procurement Substitution Request Form 002600A per Section 002600.
2. Form of Performance Bond and Labor and Material Bond: AIA Document A312-2010 "Performance Bond" and AIA Document A312-2010 "Payment Bond."
3. Form of Certificate of Insurance: AIA Document G715-2017 "Supplemental Attachment for ACORD Certificate of Insurance 25."

D. Information and Modification Forms:

1. Post-Bid Request for Substitution Form 012500A per Section 012500.
2. Digital Data Licensing Agreement: AIA Document C106 per Section 013100.
3. Form for Requests for Information (RFIs): AIA Document G716-2004 "Request for Information (RFI)."
4. Form of Request for Proposal: AIA Document G709-2018 "Proposal Request."
5. Change Order Form: AIA Document G701-2017 "Change Order."
6. Form of Architect's Memorandum for Minor Changes in the Work: AIA Document G710-2017 "Architect's Supplemental Instructions."
7. Form of Change Directive: AIA Document G714-2017 "Construction Change Directive."

E. Payment Forms:

1. Schedule of Values Form: AIA Document G703-1992 "Continuation Sheet."
2. Payment Application, Lump Sum Project: AIA Document G702-1992 "Application and Certificate for Payment" and G703-1992 "Continuation Sheet."
3. Off-Site Storage Agreement Form 012900A per Section 012900.
4. Consent of Surety Company to Off-Site Storage Agreement Form 012900B per Section 012900.
5. Form of Contractor's Affidavit: AIA Document G706-1994 "Contractor's Affidavit of Payment of Debts and Claims".
6. Form of Affidavit of Release of Liens on Progress Payments: AIA Document G901-2022 "Conditional Waiver and Release on Progress Payment".
7. Form of Affidavit of Release of Liens on Final Payments: AIA Document G903-2022 "Conditional Waiver and Release on Final Payment".
8. Form of Consent of Surety: AIA Document G707-1994 "Consent of Surety to Final Payment."

F. Closeout Forms: Refer to Section 017700 / 017700.11 “Closeout Procedures / “Closeout Procedures Forms.”

END OF DOCUMENT 006000

AIA® Document A201® – 2017

General Conditions of the Contract for Construction

for the following PROJECT:
(Name and location or address)

Klein ISD – Schindewolf Gym Addition
20903 Ella Boulevard
Spring, TX 77388

THE OWNER:
(Name, legal status and address)

Klein Independent School District
7200 Spring Cypress Rd.
Klein, TX 77379

THE ARCHITECT:
(Name, legal status and address)

DLR Group inc. of Texas, a Texas corporation
1000 Louisiana Street
Suite 1100
Houstin, TX 77002

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

Init.
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INDEX
(Topics and numbers in bold are Section headings.)

ARTICLE 1 GENERAL PROVISIONS

§ 1.1 Basic Definitions

§ 1.1.1 The Contract Documents

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

§ 1.1.2 The Contract

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

§ 1.1.3 The Work

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

§ 1.1.4 The Project

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

§ 1.1.5 The Drawings

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

§ 1.1.6 The Specifications

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

§ 1.1.7 Instruments of Service

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

§ 1.1.8 Initial Decision Maker

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

§ 1.2 Correlation and Intent of the Contract Documents

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

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

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

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

§ 1.3 Capitalization

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

§ 1.4 Interpretation

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

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

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

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

§ 1.6 Notice

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

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

§ 1.7 Digital Data Use and Transmission

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

§ 1.8 Building Information Models Use and Reliance

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

ARTICLE 2 OWNER

§ 2.1 General

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

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

§ 2.2 Evidence of the Owner's Financial Arrangements

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

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

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

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

§ 2.3 Information and Services Required of the Owner

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

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

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

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

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

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

§ 2.4 Owner's Right to Stop the Work

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

§ 2.5 Owner's Right to Carry Out the Work

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

ARTICLE 3 CONTRACTOR

§ 3.1 General

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

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

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

§ 3.2 Review of Contract Documents and Field Conditions by Contractor

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

§ 3.2.2 Because the Contract Documents are complementary, the Contractor shall, before starting each portion of the Work, carefully study and compare the various Contract Documents relative to that portion of the Work, as well as the information furnished by the Owner pursuant to Section 2.3.4, shall take field measurements of any existing conditions related to that portion of the Work, and shall observe any conditions at the site affecting it. These

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

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

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

§ 3.3 Supervision and Construction Procedures

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

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

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

§ 3.4 Labor and Materials

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

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

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

§ 3.5 Warranty

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

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

§ 3.6 Taxes

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

§ 3.7 Permits, Fees, Notices and Compliance with Laws

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

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

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

§ 3.7.4 Concealed or Unknown Conditions

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

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

§ 3.8 Allowances

§ 3.8.1 The Contractor shall include in the Contract Sum all allowances stated in the Contract Documents. Items covered by allowances shall be supplied for such amounts and by such persons or entities as the Owner may direct, but the Contractor shall not be required to employ persons or entities to whom the Contractor has reasonable objection.

§ 3.8.2 Unless otherwise provided in the Contract Documents,

.1 allowances shall cover the cost to the Contractor of materials and equipment delivered at the site and all required taxes, less applicable trade discounts;

.2 Contractor's costs for unloading and handling at the site, labor, installation costs, overhead, profit, and other expenses contemplated for stated allowance amounts shall be included in the Contract Sum but not in the allowances; and

.3 whenever costs are more than or less than allowances, the Contract Sum shall be adjusted accordingly by Change Order. The amount of the Change Order shall reflect (1) the difference between actual costs and the allowances under Section 3.8.2.1 and (2) changes in Contractor's costs under Section 3.8.2.2.

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

§ 3.9 Superintendent

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

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

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

§ 3.10 Contractor's Construction and Submittal Schedules

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

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

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

§ 3.11 Documents and Samples at the Site

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

§ 3.12 Shop Drawings, Product Data and Samples

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

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

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

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

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

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

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

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

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

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

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

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

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

§ 3.13 Use of Site

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

§ 3.14 Cutting and Patching

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

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

§ 3.15 Cleaning Up

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

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

§ 3.16 Access to Work

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

§ 3.17 Royalties, Patents and Copyrights

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

§ 3.18 Indemnification

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

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

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

ARTICLE 4 ARCHITECT

§ 4.1 General

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

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

§ 4.2 Administration of the Contract

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

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

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

§ 4.2.4 Communications

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

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

§ 4.2.6 The Architect has authority to reject Work that does not conform to the Contract Documents. Whenever the Architect considers it necessary or advisable, the Architect will have authority to require inspection or testing of the

Work in accordance with Sections 13.4.2 and 13.4.3, whether or not the Work is fabricated, installed or completed. However, neither this authority of the Architect nor a decision made in good faith either to exercise or not to exercise such authority shall give rise to a duty or responsibility of the Architect to the Contractor, Subcontractors, suppliers, their agents or employees, or other persons or entities performing portions of the Work.

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

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

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

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

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

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

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

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

ARTICLE 5 SUBCONTRACTORS

§ 5.1 Definitions

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

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

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

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

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

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

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

§ 5.3 Subcontractual Relations

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

§ 5.4 Contingent Assignment of Subcontracts

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

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

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

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

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

ARTICLE 6 CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS

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

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

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

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

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

§ 6.2 Mutual Responsibility

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

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

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

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

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

§ 6.3 Owner's Right to Clean Up

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

ARTICLE 7 CHANGES IN THE WORK

§ 7.1 General

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

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

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

§ 7.2 Change Orders

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

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

§ 7.3 Construction Change Directives

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

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

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

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

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

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

.3 Rental costs of machinery and equipment, exclusive of hand tools, whether rented from the Contractor or others;

.4 Costs of premiums for all bonds and insurance, permit fees, and sales, use, or similar taxes, directly related to the change; and

.5 Costs of supervision and field office personnel directly attributable to the change.

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

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

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

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

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

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

§ 7.4 Minor Changes in the Work

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

ARTICLE 8 TIME

§ 8.1 Definitions

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

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

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

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

§ 8.2 Progress and Completion

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

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

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

§ 8.3 Delays and Extensions of Time

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

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

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

ARTICLE 9 PAYMENTS AND COMPLETION

§ 9.1 Contract Sum

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

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

§ 9.2 Schedule of Values

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

§ 9.3 Applications for Payment

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

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

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

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

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

§ 9.4 Certificates for Payment

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

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

§ 9.5 Decisions to Withhold Certification

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

- **.1** defective Work not remedied;
- **.2** third party claims filed or reasonable evidence indicating probable filing of such claims, unless security acceptable to the Owner is provided by the Contractor;
- **.3** failure of the Contractor to make payments properly to Subcontractors or suppliers for labor, materials or equipment;
- **.4** reasonable evidence that the Work cannot be completed for the unpaid balance of the Contract Sum;

.5 damage to the Owner or a Separate Contractor;
.6 reasonable evidence that the Work will not be completed within the Contract Time, and that the unpaid balance would not be adequate to cover actual or liquidated damages for the anticipated delay; or
.7 repeated failure to carry out the Work in accordance with the Contract Documents.

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

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

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

§ 9.6 Progress Payments

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

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

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

§ 9.6.4 The Owner has the right to request written evidence from the Contractor that the Contractor has properly paid Subcontractors and suppliers amounts paid by the Owner to the Contractor for subcontracted Work. If the Contractor fails to furnish such evidence within seven days, the Owner shall have the right to contact Subcontractors and suppliers to ascertain whether they have been properly paid. Neither the Owner nor Architect shall have an obligation to pay, or to see to the payment of money to, a Subcontractor or supplier, except as may otherwise be required by law.

§ 9.6.5 The Contractor's payments to suppliers shall be treated in a manner similar to that provided in Sections 9.6.2, 9.6.3 and 9.6.4.

§ 9.6.6 A Certificate for Payment, a progress payment, or partial or entire use or occupancy of the Project by the Owner shall not constitute acceptance of Work not in accordance with the Contract Documents.

§ 9.6.7 Unless the Contractor provides the Owner with a payment bond in the full penal sum of the Contract Sum, payments received by the Contractor for Work properly performed by Subcontractors or provided by suppliers shall be held by the Contractor for those Subcontractors or suppliers who performed Work or furnished materials, or both, under contract with the Contractor for which payment was made by the Owner. Nothing contained herein shall require money to be placed in a separate account and not commingled with money of the Contractor, create any fiduciary liability or tort liability on the part of the Contractor for breach of trust, or entitle any person or entity to an award of punitive damages against the Contractor for breach of the requirements of this provision.

§ 9.6.8 Provided the Owner has fulfilled its payment obligations under the Contract Documents, the Contractor shall defend and indemnify the Owner from all loss, liability, damage or expense, including reasonable attorney's fees and litigation expenses, arising out of any lien claim or other claim for payment by any Subcontractor or supplier of any tier. Upon receipt of notice of a lien claim or other claim for payment, the Owner shall notify the Contractor. If approved by the applicable court, when required, the Contractor may substitute a surety bond for the property against which the lien or other claim for payment has been asserted.

§ 9.7 Failure of Payment

If the Architect does not issue a Certificate for Payment, through no fault of the Contractor, within seven days after receipt of the Contractor's Application for Payment, or if the Owner does not pay the Contractor within seven days after the date established in the Contract Documents, the amount certified by the Architect or awarded by binding dispute resolution, then the Contractor may, upon seven additional days' notice to the Owner and Architect, stop the Work until payment of the amount owing has been received. The Contract Time shall be extended appropriately and the Contract Sum shall be increased by the amount of the Contractor's reasonable costs of shutdown, delay and start-up, plus interest as provided for in the Contract Documents.

§ 9.8 Substantial Completion

§ 9.8.1 Substantial Completion is the stage in the progress of the Work when the Work or designated portion thereof is sufficiently complete in accordance with the Contract Documents so that the Owner can occupy or utilize the Work for its intended use.

§ 9.8.2 When the Contractor considers that the Work, or a portion thereof which the Owner agrees to accept separately, is substantially complete, the Contractor shall prepare and submit to the Architect a comprehensive list of items to be completed or corrected prior to final payment. Failure to include an item on such list does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract Documents.

§ 9.8.3 Upon receipt of the Contractor's list, the Architect will make an inspection to determine whether the Work or designated portion thereof is substantially complete. If the Architect's inspection discloses any item, whether or not included on the Contractor's list, which is not sufficiently complete in accordance with the Contract Documents so that the Owner can occupy or utilize the Work or designated portion thereof for its intended use, the Contractor shall, before issuance of the Certificate of Substantial Completion, complete or correct such item upon notification by the Architect. In such case, the Contractor shall then submit a request for another inspection by the Architect to determine Substantial Completion.

§ 9.8.4 When the Work or designated portion thereof is substantially complete, the Architect will prepare a Certificate of Substantial Completion that shall establish the date of Substantial Completion; establish responsibilities of the Owner and Contractor for security, maintenance, heat, utilities, damage to the Work and insurance; and fix the time within which the Contractor shall finish all items on the list accompanying the Certificate. Warranties required by the Contract Documents shall commence on the date of Substantial Completion of the Work or designated portion thereof unless otherwise provided in the Certificate of Substantial Completion.

§ 9.8.5 The Certificate of Substantial Completion shall be submitted to the Owner and Contractor for their written acceptance of responsibilities assigned to them in the Certificate. Upon such acceptance, and consent of surety if any, the Owner shall make payment of retainage applying to the Work or designated portion thereof. Such payment shall be adjusted for Work that is incomplete or not in accordance with the requirements of the Contract Documents.

§ 9.9 Partial Occupancy or Use

§ 9.9.1 The Owner may occupy or use any completed or partially completed portion of the Work at any stage when such portion is designated by separate agreement with the Contractor, provided such occupancy or use is consented to by the insurer and authorized by public authorities having jurisdiction over the Project. Such partial occupancy or use may commence whether or not the portion is substantially complete, provided the Owner and Contractor have accepted in writing the responsibilities assigned to each of them for payments, retainage, if any, security, maintenance, heat, utilities, damage to the Work and insurance, and have agreed in writing concerning the period for correction of the Work and commencement of warranties required by the Contract Documents. When the Contractor considers a portion substantially complete, the Contractor shall prepare and submit a list to the Architect as provided under Section 9.8.2. Consent of the Contractor to partial occupancy or use shall not be unreasonably withheld. The stage of the progress of the Work shall be determined by written agreement between the Owner and Contractor or, if no agreement is reached, by decision of the Architect.

§ 9.9.2 Immediately prior to such partial occupancy or use, the Owner, Contractor, and Architect shall jointly inspect the area to be occupied or portion of the Work to be used in order to determine and record the condition of the Work.

§ 9.9.3 Unless otherwise agreed upon, partial occupancy or use of a portion or portions of the Work shall not constitute acceptance of Work not complying with the requirements of the Contract Documents.

§ 9.10 Final Completion and Final Payment

§ 9.10.1 Upon receipt of the Contractor's notice that the Work is ready for final inspection and acceptance and upon receipt of a final Application for Payment, the Architect will promptly make such inspection. When the Architect finds the Work acceptable under the Contract Documents and the Contract fully performed, the Architect will promptly issue a final Certificate for Payment stating that to the best of the Architect's knowledge, information and belief, and on the basis of the Architect's on-site visits and inspections, the Work has been completed in accordance with the Contract Documents and that the entire balance found to be due the Contractor and noted in the final Certificate is due and payable. The Architect's final Certificate for Payment will constitute a further representation that conditions listed in Section 9.10.2 as precedent to the Contractor's being entitled to final payment have been fulfilled.

§ 9.10.2 Neither final payment nor any remaining retained percentage shall become due until the Contractor submits to the Architect (1) an affidavit that payrolls, bills for materials and equipment, and other indebtedness connected with the Work for which the Owner or the Owner's property might be responsible or encumbered (less amounts withheld by Owner) have been paid or otherwise satisfied, (2) a certificate evidencing that insurance required by the Contract Documents to remain in force after final payment is currently in effect, (3) a written statement that the Contractor knows of no reason that the insurance will not be renewable to cover the period required by the Contract Documents, (4) consent of surety, if any, to final payment, (5) documentation of any special warranties, such as manufacturers' warranties or specific Subcontractor warranties, and (6) if required by the Owner, other data establishing payment or satisfaction of obligations, such as receipts and releases and waivers of liens, claims, security interests, or encumbrances arising out of the Contract, to the extent and in such form as may be designated by the Owner. If a Subcontractor refuses to furnish a release or waiver required by the Owner, the Contractor may furnish a bond satisfactory to the Owner to indemnify the Owner against such lien, claim, security interest, or encumbrance. If a lien, claim, security interest, or encumbrance remains unsatisfied after payments are made, the Contractor shall refund to the Owner all money that the Owner may be compelled to pay in discharging the lien, claim, security interest, or encumbrance, including all costs and reasonable attorneys' fees.

§ 9.10.3 If, after Substantial Completion of the Work, final completion thereof is materially delayed through no fault of the Contractor or by issuance of Change Orders affecting final completion, and the Architect so confirms, the Owner shall, upon application by the Contractor and certification by the Architect, and without terminating the Contract, make payment of the balance due for that portion of the Work fully completed, corrected, and accepted. If the remaining balance for Work not fully completed or corrected is less than retainage stipulated in the Contract Documents, and if bonds have been furnished, the written consent of the surety to payment of the balance due for that portion of the Work fully completed and accepted shall be submitted by the Contractor to the Architect prior to certification of such payment. Such payment shall be made under terms and conditions governing final payment, except that it shall not constitute a waiver of Claims.

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

- **.1** liens, Claims, security interests, or encumbrances arising out of the Contract and unsettled;
- **.2** failure of the Work to comply with the requirements of the Contract Documents;
- **.3** terms of special warranties required by the Contract Documents; or
- **.4** audits performed by the Owner, if permitted by the Contract Documents, after final payment.

§ 9.10.5 Acceptance of final payment by the Contractor, a Subcontractor, or a supplier, shall constitute a waiver of claims by that payee except those previously made in writing and identified by that payee as unsettled at the time of final Application for Payment.

ARTICLE 10 PROTECTION OF PERSONS AND PROPERTY

§ 10.1 Safety Precautions and Programs

The Contractor shall be responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the performance of the Contract.

§ 10.2 Safety of Persons and Property

§ 10.2.1 The Contractor shall take reasonable precautions for safety of, and shall provide reasonable protection to prevent damage, injury, or loss to

- **.1** employees on the Work and other persons who may be affected thereby;

.2 the Work and materials and equipment to be incorporated therein, whether in storage on or off the site, under care, custody, or control of the Contractor, a Subcontractor, or a Sub-subcontractor; and

.3 other property at the site or adjacent thereto, such as trees, shrubs, lawns, walks, pavements, roadways, structures, and utilities not designated for removal, relocation, or replacement in the course of construction.

§ 10.2.2 The Contractor shall comply with, and give notices required by applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities, bearing on safety of persons or property or their protection from damage, injury, or loss.

§ 10.2.3 The Contractor shall implement, erect, and maintain, as required by existing conditions and performance of the Contract, reasonable safeguards for safety and protection, including posting danger signs and other warnings against hazards; promulgating safety regulations; and notifying the owners and users of adjacent sites and utilities of the safeguards.

§ 10.2.4 When use or storage of explosives or other hazardous materials or equipment, or unusual methods are necessary for execution of the Work, the Contractor shall exercise utmost care and carry on such activities under supervision of properly qualified personnel.

§ 10.2.5 The Contractor shall promptly remedy damage and loss (other than damage or loss insured under property insurance required by the Contract Documents) to property referred to in Sections 10.2.1.2 and 10.2.1.3 caused in whole or in part by the Contractor, a Subcontractor, a Sub-subcontractor, or anyone directly or indirectly employed by any of them, or by anyone for whose acts they may be liable and for which the Contractor is responsible under Sections 10.2.1.2 and 10.2.1.3. The Contractor may make a Claim for the cost to remedy the damage or loss to the extent such damage or loss is attributable to acts or omissions of the Owner or Architect or anyone directly or indirectly employed by either of them, or by anyone for whose acts either of them may be liable, and not attributable to the fault or negligence of the Contractor. The foregoing obligations of the Contractor are in addition to the Contractor's obligations under Section 3.18.

§ 10.2.6 The Contractor shall designate a responsible member of the Contractor's organization at the site whose duty shall be the prevention of accidents. This person shall be the Contractor's superintendent unless otherwise designated by the Contractor in writing to the Owner and Architect.

§ 10.2.7 The Contractor shall not permit any part of the construction or site to be loaded so as to cause damage or create an unsafe condition.

§ 10.2.8 Injury or Damage to Person or Property

If either party suffers injury or damage to person or property because of an act or omission of the other party, or of others for whose acts such party is legally responsible, notice of the injury or damage, whether or not insured, shall be given to the other party within a reasonable time not exceeding 21 days after discovery. The notice shall provide sufficient detail to enable the other party to investigate the matter.

§ 10.3 Hazardous Materials and Substances

§ 10.3.1 The Contractor is responsible for compliance with any requirements included in the Contract Documents regarding hazardous materials or substances. If the Contractor encounters a hazardous material or substance not addressed in the Contract Documents and if reasonable precautions will be inadequate to prevent foreseeable bodily injury or death to persons resulting from a material or substance, including but not limited to asbestos or polychlorinated biphenyl (PCB), encountered on the site by the Contractor, the Contractor shall, upon recognizing the condition, immediately stop Work in the affected area and notify the Owner and Architect of the condition.

§ 10.3.2 Upon receipt of the Contractor's notice, the Owner shall obtain the services of a licensed laboratory to verify the presence or absence of the material or substance reported by the Contractor and, in the event such material or substance is found to be present, to cause it to be rendered harmless. Unless otherwise required by the Contract Documents, the Owner shall furnish in writing to the Contractor and Architect the names and qualifications of persons or entities who are to perform tests verifying the presence or absence of the material or substance or who are to perform the task of removal or safe containment of the material or substance. The Contractor and the Architect will promptly reply to the Owner in writing stating whether or not either has reasonable objection to the persons or entities

proposed by the Owner. If either the Contractor or Architect has an objection to a person or entity proposed by the Owner, the Owner shall propose another to whom the Contractor and the Architect have no reasonable objection. When the material or substance has been rendered harmless, Work in the affected area shall resume upon written agreement of the Owner and Contractor. By Change Order, the Contract Time shall be extended appropriately and the Contract Sum shall be increased by the amount of the Contractor's reasonable additional costs of shutdown, delay, and start-up.

§ 10.3.3 To the fullest extent permitted by law, the Owner shall indemnify and hold harmless the Contractor, Subcontractors, Architect, Architect's consultants, and agents and employees of any of them from and against claims, damages, losses, and expenses, including but not limited to attorneys' fees, arising out of or resulting from performance of the Work in the affected area if in fact the material or substance presents the risk of bodily injury or death as described in Section 10.3.1 and has not been rendered harmless, provided that such claim, damage, loss, or expense is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself), except to the extent that such damage, loss, or expense is due to the fault or negligence of the party seeking indemnity.

§ 10.3.4 The Owner shall not be responsible under this Section 10.3 for hazardous materials or substances the Contractor brings to the site unless such materials or substances are required by the Contract Documents. The Owner shall be responsible for hazardous materials or substances required by the Contract Documents, except to the extent of the Contractor's fault or negligence in the use and handling of such materials or substances.

§ 10.3.5 The Contractor shall reimburse the Owner for the cost and expense the Owner incurs (1) for remediation of hazardous materials or substances the Contractor brings to the site and negligently handles, or (2) where the Contractor fails to perform its obligations under Section 10.3.1, except to the extent that the cost and expense are due to the Owner's fault or negligence.

§ 10.3.6 If, without negligence on the part of the Contractor, the Contractor is held liable by a government agency for the cost of remediation of a hazardous material or substance solely by reason of performing Work as required by the Contract Documents, the Owner shall reimburse the Contractor for all cost and expense thereby incurred.

§ 10.4 Emergencies

In an emergency affecting safety of persons or property, the Contractor shall act, at the Contractor's discretion, to prevent threatened damage, injury, or loss. Additional compensation or extension of time claimed by the Contractor on account of an emergency shall be determined as provided in Article 15 and Article 7.

ARTICLE 11 INSURANCE AND BONDS

§ 11.1 Contractor's Insurance and Bonds

§ 11.1.1 The Contractor shall purchase and maintain insurance of the types and limits of liability, containing the endorsements, and subject to the terms and conditions, as described in the Agreement or elsewhere in the Contract Documents. The Contractor shall purchase and maintain the required insurance from an insurance company or insurance companies lawfully authorized to issue insurance in the jurisdiction where the Project is located. The Owner, Architect, and Architect's consultants shall be named as additional insureds under the Contractor's commercial general liability policy or as otherwise described in the Contract Documents.

§ 11.1.2 The Contractor shall provide surety bonds of the types, for such penal sums, and subject to such terms and conditions as required by the Contract Documents. The Contractor shall purchase and maintain the required bonds from a company or companies lawfully authorized to issue surety bonds in the jurisdiction where the Project is located.

§ 11.1.3 Upon the request of any person or entity appearing to be a potential beneficiary of bonds covering payment of obligations arising under the Contract, the Contractor shall promptly furnish a copy of the bonds or shall authorize a copy to be furnished.

§ 11.1.4 Notice of Cancellation or Expiration of Contractor's Required Insurance. Within three (3) business days of the date the Contractor becomes aware of an impending or actual cancellation or expiration of any insurance required by the Contract Documents, the Contractor shall provide notice to the Owner of such impending or actual cancellation or expiration. Upon receipt of notice from the Contractor, the Owner shall, unless the lapse in coverage arises from an act or omission of the Owner, have the right to stop the Work until the lapse in coverage has been cured by the

procurement of replacement coverage by the Contractor. The furnishing of notice by the Contractor shall not relieve the Contractor of any contractual obligation to provide any required coverage.

§ 11.2 Owner's Insurance

§ 11.2.1 The Owner shall purchase and maintain insurance of the types and limits of liability, containing the endorsements, and subject to the terms and conditions, as described in the Agreement or elsewhere in the Contract Documents. The Owner shall purchase and maintain the required insurance from an insurance company or insurance companies lawfully authorized to issue insurance in the jurisdiction where the Project is located.

§ 11.2.2 Failure to Purchase Required Property Insurance. If the Owner fails to purchase and maintain the required property insurance, with all of the coverages and in the amounts described in the Agreement or elsewhere in the Contract Documents, the Owner shall inform the Contractor in writing prior to commencement of the Work. Upon receipt of notice from the Owner, the Contractor may delay commencement of the Work and may obtain insurance that will protect the interests of the Contractor, Subcontractors, and Sub-Subcontractors in the Work. When the failure to provide coverage has been cured or resolved, the Contract Sum and Contract Time shall be equitably adjusted. In the event the Owner fails to procure coverage, the Owner waives all rights against the Contractor, Subcontractors, and Sub-subcontractors to the extent the loss to the Owner would have been covered by the insurance to have been procured by the Owner. The cost of the insurance shall be charged to the Owner by a Change Order. If the Owner does not provide written notice, and the Contractor is damaged by the failure or neglect of the Owner to purchase or maintain the required insurance, the Owner shall reimburse the Contractor for all reasonable costs and damages attributable thereto.

§ 11.2.3 Notice of Cancellation or Expiration of Owner's Required Property Insurance. Within three (3) business days of the date the Owner becomes aware of an impending or actual cancellation or expiration of any property insurance required by the Contract Documents, the Owner shall provide notice to the Contractor of such impending or actual cancellation or expiration. Unless the lapse in coverage arises from an act or omission of the Contractor: (1) the Contractor, upon receipt of notice from the Owner, shall have the right to stop the Work until the lapse in coverage has been cured by the procurement of replacement coverage by either the Owner or the Contractor; (2) the Contract Time and Contract Sum shall be equitably adjusted; and (3) the Owner waives all rights against the Contractor, Subcontractors, and Sub-subcontractors to the extent any loss to the Owner would have been covered by the insurance had it not expired or been cancelled. If the Contractor purchases replacement coverage, the cost of the insurance shall be charged to the Owner by an appropriate Change Order. The furnishing of notice by the Owner shall not relieve the Owner of any contractual obligation to provide required insurance.

§ 11.3 Waivers of Subrogation

§ 11.3.1 The Owner and Contractor waive all rights against (1) each other and any of their subcontractors, sub-subcontractors, agents, and employees, each of the other; (2) the Architect and Architect's consultants; and (3) Separate Contractors, if any, and any of their subcontractors, sub-subcontractors, agents, and employees, for damages caused by fire, or other causes of loss, to the extent those losses are covered by property insurance required by the Agreement or other property insurance applicable to the Project, except such rights as they have to proceeds of such insurance. The Owner or Contractor, as appropriate, shall require similar written waivers in favor of the individuals and entities identified above from the Architect, Architect's consultants, Separate Contractors, subcontractors, and sub-subcontractors. The policies of insurance purchased and maintained by each person or entity agreeing to waive claims pursuant to this section 11.3.1 shall not prohibit this waiver of subrogation. This waiver of subrogation shall be effective as to a person or entity (1) even though that person or entity would otherwise have a duty of indemnification, contractual or otherwise, (2) even though that person or entity did not pay the insurance premium directly or indirectly, or (3) whether or not the person or entity had an insurable interest in the damaged property.

§ 11.3.2 If during the Project construction period the Owner insures properties, real or personal or both, at or adjacent to the site by property insurance under policies separate from those insuring the Project, or if after final payment property insurance is to be provided on the completed Project through a policy or policies other than those insuring the Project during the construction period, to the extent permissible by such policies, the Owner waives all rights in accordance with the terms of Section 11.3.1 for damages caused by fire or other causes of loss covered by this separate property insurance.

§ 11.4 Loss of Use, Business Interruption, and Delay in Completion Insurance

The Owner, at the Owner's option, may purchase and maintain insurance that will protect the Owner against loss of use of the Owner's property, or the inability to conduct normal operations, due to fire or other causes of loss. The Owner waives all rights of action against the Contractor and Architect for loss of use of the Owner's property, due to fire or other hazards however caused.

§11.5 Adjustment and Settlement of Insured Loss

§ 11.5.1 A loss insured under the property insurance required by the Agreement shall be adjusted by the Owner as fiduciary and made payable to the Owner as fiduciary for the insureds, as their interests may appear, subject to requirements of any applicable mortgagee clause and of Section 11.5.2. The Owner shall pay the Architect and Contractor their just shares of insurance proceeds received by the Owner, and by appropriate agreements the Architect and Contractor shall make payments to their consultants and Subcontractors in similar manner.

§ 11.5.2 Prior to settlement of an insured loss, the Owner shall notify the Contractor of the terms of the proposed settlement as well as the proposed allocation of the insurance proceeds. The Contractor shall have 14 days from receipt of notice to object to the proposed settlement or allocation of the proceeds. If the Contractor does not object, the Owner shall settle the loss and the Contractor shall be bound by the settlement and allocation. Upon receipt, the Owner shall deposit the insurance proceeds in a separate account and make the appropriate distributions. Thereafter, if no other agreement is made or the Owner does not terminate the Contract for convenience, the Owner and Contractor shall execute a Change Order for reconstruction of the damaged or destroyed Work in the amount allocated for that purpose. If the Contractor timely objects to either the terms of the proposed settlement or the allocation of the proceeds, the Owner may proceed to settle the insured loss, and any dispute between the Owner and Contractor arising out of the settlement or allocation of the proceeds shall be resolved pursuant to Article 15. Pending resolution of any dispute, the Owner may issue a Construction Change Directive for the reconstruction of the damaged or destroyed Work.

ARTICLE 12 UNCOVERING AND CORRECTION OF WORK

§ 12.1 Uncovering of Work

§ 12.1.1 If a portion of the Work is covered contrary to the Architect's request or to requirements specifically expressed in the Contract Documents, it must, if requested in writing by the Architect, be uncovered for the Architect's examination and be replaced at the Contractor's expense without change in the Contract Time.

§ 12.1.2 If a portion of the Work has been covered that the Architect has not specifically requested to examine prior to its being covered, the Architect may request to see such Work and it shall be uncovered by the Contractor. If such Work is in accordance with the Contract Documents, the Contractor shall be entitled to an equitable adjustment to the Contract Sum and Contract Time as may be appropriate. If such Work is not in accordance with the Contract Documents, the costs of uncovering the Work, and the cost of correction, shall be at the Contractor's expense.

§ 12.2 Correction of Work

§ 12.2.1 Before Substantial Completion

The Contractor shall promptly correct Work rejected by the Architect or failing to conform to the requirements of the Contract Documents, discovered before Substantial Completion and whether or not fabricated, installed or completed. Costs of correcting such rejected Work, including additional testing and inspections, the cost of uncovering and replacement, and compensation for the Architect's services and expenses made necessary thereby, shall be at the Contractor's expense.

§ 12.2.2 After Substantial Completion

§ 12.2.2.1 In addition to the Contractor's obligations under Section 3.5, if, within one year after the date of Substantial Completion of the Work or designated portion thereof or after the date for commencement of warranties established under Section 9.9.1, or by terms of any applicable special warranty required by the Contract Documents, any of the Work is found to be not in accordance with the requirements of the Contract Documents, the Contractor shall correct it promptly after receipt of notice from the Owner to do so, unless the Owner has previously given the Contractor a written acceptance of such condition. The Owner shall give such notice promptly after discovery of the condition. During the one-year period for correction of Work, if the Owner fails to notify the Contractor and give the Contractor an opportunity to make the correction, the Owner waives the rights to require correction by the Contractor and to make a claim for breach of warranty. If the Contractor fails to correct nonconforming Work within a reasonable time during that period after receipt of notice from the Owner or Architect, the Owner may correct it in accordance with Section 2.5.

§ 12.2.2.2 The one-year period for correction of Work shall be extended with respect to portions of Work first performed after Substantial Completion by the period of time between Substantial Completion and the actual completion of that portion of the Work.

§ 12.2.2.3 The one-year period for correction of Work shall not be extended by corrective Work performed by the Contractor pursuant to this Section 12.2.

§ 12.2.3 The Contractor shall remove from the site portions of the Work that are not in accordance with the requirements of the Contract Documents and are neither corrected by the Contractor nor accepted by the Owner.

§ 12.2.4 The Contractor shall bear the cost of correcting destroyed or damaged construction of the Owner or Separate Contractors, whether completed or partially completed, caused by the Contractor's correction or removal of Work that is not in accordance with the requirements of the Contract Documents.

§ 12.2.5 Nothing contained in this Section 12.2 shall be construed to establish a period of limitation with respect to other obligations the Contractor has under the Contract Documents. Establishment of the one-year period for correction of Work as described in Section 12.2.2 relates only to the specific obligation of the Contractor to correct the Work, and has no relationship to the time within which the obligation to comply with the Contract Documents may be sought to be enforced, nor to the time within which proceedings may be commenced to establish the Contractor's liability with respect to the Contractor's obligations other than specifically to correct the Work.

§ 12.3 Acceptance of Nonconforming Work

If the Owner prefers to accept Work that is not in accordance with the requirements of the Contract Documents, the Owner may do so instead of requiring its removal and correction, in which case the Contract Sum will be reduced as appropriate and equitable. Such adjustment shall be effected whether or not final payment has been made.

ARTICLE 13 MISCELLANEOUS PROVISIONS

§ 13.1 Governing Law

The Contract shall be governed by the law of the place where the Project is located, excluding that jurisdiction's choice of law rules. If the parties have selected arbitration as the method of binding dispute resolution, the Federal Arbitration Act shall govern Section 15.4.

§ 13.2 Successors and Assigns

§ 13.2.1 The Owner and Contractor respectively bind themselves, their partners, successors, assigns, and legal representatives to covenants, agreements, and obligations contained in the Contract Documents. Except as provided in Section 13.2.2, neither party to the Contract shall assign the Contract as a whole without written consent of the other. If either party attempts to make an assignment without such consent, that party shall nevertheless remain legally responsible for all obligations under the Contract.

§ 13.2.2 The Owner may, without consent of the Contractor, assign the Contract to a lender providing construction financing for the Project, if the lender assumes the Owner's rights and obligations under the Contract Documents. The Contractor shall execute all consents reasonably required to facilitate the assignment.

§ 13.3 Rights and Remedies

§ 13.3.1 Duties and obligations imposed by the Contract Documents and rights and remedies available thereunder shall be in addition to and not a limitation of duties, obligations, rights, and remedies otherwise imposed or available by law.

§ 13.3.2 No action or failure to act by the Owner, Architect, or Contractor shall constitute a waiver of a right or duty afforded them under the Contract, nor shall such action or failure to act constitute approval of or acquiescence in a breach thereunder, except as may be specifically agreed upon in writing.

§ 13.4 Tests and Inspections

§ 13.4.1 Tests, inspections, and approvals of portions of the Work shall be made as required by the Contract Documents and by applicable laws, statutes, ordinances, codes, rules, and regulations or lawful orders of public authorities. Unless otherwise provided, the Contractor shall make arrangements for such tests, inspections, and

approvals with an independent testing laboratory or entity acceptable to the Owner, or with the appropriate public authority, and shall bear all related costs of tests, inspections, and approvals. The Contractor shall give the Architect timely notice of when and where tests and inspections are to be made so that the Architect may be present for such procedures. The Owner shall bear costs of tests, inspections, or approvals that do not become requirements until after bids are received or negotiations concluded. The Owner shall directly arrange and pay for tests, inspections, or approvals where building codes or applicable laws or regulations so require.

§ 13.4.2 If the Architect, Owner, or public authorities having jurisdiction determine that portions of the Work require additional testing, inspection, or approval not included under Section 13.4.1, the Architect will, upon written authorization from the Owner, instruct the Contractor to make arrangements for such additional testing, inspection, or approval, by an entity acceptable to the Owner, and the Contractor shall give timely notice to the Architect of when and where tests and inspections are to be made so that the Architect may be present for such procedures. Such costs, except as provided in Section 13.4.3, shall be at the Owner's expense.

§ 13.4.3 If procedures for testing, inspection, or approval under Sections 13.4.1 and 13.4.2 reveal failure of the portions of the Work to comply with requirements established by the Contract Documents, all costs made necessary by such failure, including those of repeated procedures and compensation for the Architect's services and expenses, shall be at the Contractor's expense.

§ 13.4.4 Required certificates of testing, inspection, or approval shall, unless otherwise required by the Contract Documents, be secured by the Contractor and promptly delivered to the Architect.

§ 13.4.5 If the Architect is to observe tests, inspections, or approvals required by the Contract Documents, the Architect will do so promptly and, where practicable, at the normal place of testing.

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

§ 13.5 Interest

Payments due and unpaid under the Contract Documents shall bear interest from the date payment is due at the rate the parties agree upon in writing or, in the absence thereof, at the legal rate prevailing from time to time at the place where the Project is located.

ARTICLE 14 TERMINATION OR SUSPENSION OF THE CONTRACT

§ 14.1 Termination by the Contractor

§ 14.1.1 The Contractor may terminate the Contract if the Work is stopped for a period of 30 consecutive days through no act or fault of the Contractor, a Subcontractor, a Sub-subcontractor, their agents or employees, or any other persons or entities performing portions of the Work, for any of the following reasons:

- **.1** Issuance of an order of a court or other public authority having jurisdiction that requires all Work to be stopped;
- **.2** An act of government, such as a declaration of national emergency, that requires all Work to be stopped;
- **.3** Because the Architect has not issued a Certificate for Payment and has not notified the Contractor of the reason for withholding certification as provided in Section 9.4.1, or because the Owner has not made payment on a Certificate for Payment within the time stated in the Contract Documents; or
- **.4** The Owner has failed to furnish to the Contractor reasonable evidence as required by Section 2.2.

§ 14.1.2 The Contractor may terminate the Contract if, through no act or fault of the Contractor, a Subcontractor, a Sub-subcontractor, their agents or employees, or any other persons or entities performing portions of the Work, repeated suspensions, delays, or interruptions of the entire Work by the Owner as described in Section 14.3, constitute in the aggregate more than 100 percent of the total number of days scheduled for completion, or 120 days in any 365-day period, whichever is less.

§ 14.1.3 If one of the reasons described in Section 14.1.1 or 14.1.2 exists, the Contractor may, upon seven days' notice to the Owner and Architect, terminate the Contract and recover from the Owner payment for Work executed, as well as reasonable overhead and profit on Work not executed, and costs incurred by reason of such termination.

§ 14.1.4 If the Work is stopped for a period of 60 consecutive days through no act or fault of the Contractor, a Subcontractor, a Sub-subcontractor, or their agents or employees or any other persons or entities performing portions of the Work because the Owner has repeatedly failed to fulfill the Owner's obligations under the Contract Documents with respect to matters important to the progress of the Work, the Contractor may, upon seven additional days' notice to the Owner and the Architect, terminate the Contract and recover from the Owner as provided in Section 14.1.3.

§ 14.2 Termination by the Owner for Cause

§ 14.2.1 The Owner may terminate the Contract if the Contractor

- **.1** repeatedly refuses or fails to supply enough properly skilled workers or proper materials;
- **.2** fails to make payment to Subcontractors or suppliers in accordance with the respective agreements between the Contractor and the Subcontractors or suppliers;
- **.3** repeatedly disregards applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of a public authority; or
- **.4** otherwise is guilty of substantial breach of a provision of the Contract Documents.

§ 14.2.2 When any of the reasons described in Section 14.2.1 exist, and upon certification by the Architect that sufficient cause exists to justify such action, the Owner may, without prejudice to any other rights or remedies of the Owner and after giving the Contractor and the Contractor's surety, if any, seven days' notice, terminate employment of the Contractor and may, subject to any prior rights of the surety:

- **.1** Exclude the Contractor from the site and take possession of all materials, equipment, tools, and construction equipment and machinery thereon owned by the Contractor;
- **.2** Accept assignment of subcontracts pursuant to Section 5.4; and
- **.3** Finish the Work by whatever reasonable method the Owner may deem expedient. Upon written request of the Contractor, the Owner shall furnish to the Contractor a detailed accounting of the costs incurred by the Owner in finishing the Work.

§ 14.2.3 When the Owner terminates the Contract for one of the reasons stated in Section 14.2.1, the Contractor shall not be entitled to receive further payment until the Work is finished.

§ 14.2.4 If the unpaid balance of the Contract Sum exceeds costs of finishing the Work, including compensation for the Architect's services and expenses made necessary thereby, and other damages incurred by the Owner and not expressly waived, such excess shall be paid to the Contractor. If such costs and damages exceed the unpaid balance, the Contractor shall pay the difference to the Owner. The amount to be paid to the Contractor or Owner, as the case may be, shall be certified by the Initial Decision Maker, upon application, and this obligation for payment shall survive termination of the Contract.

§ 14.3 Suspension by the Owner for Convenience

§ 14.3.1 The Owner may, without cause, order the Contractor in writing to suspend, delay or interrupt the Work, in whole or in part for such period of time as the Owner may determine.

§ 14.3.2 The Contract Sum and Contract Time shall be adjusted for increases in the cost and time caused by suspension, delay, or interruption under Section 14.3.1. Adjustment of the Contract Sum shall include profit. No adjustment shall be made to the extent

- **.1** that performance is, was, or would have been, so suspended, delayed, or interrupted, by another cause for which the Contractor is responsible; or
- **.2** that an equitable adjustment is made or denied under another provision of the Contract.

§ 14.4 Termination by the Owner for Convenience

§ 14.4.1 The Owner may, at any time, terminate the Contract for the Owner's convenience and without cause.

§ 14.4.2 Upon receipt of notice from the Owner of such termination for the Owner's convenience, the Contractor shall

- **.1** cease operations as directed by the Owner in the notice;
- **.2** take actions necessary, or that the Owner may direct, for the protection and preservation of the Work; and
- **.3** except for Work directed to be performed prior to the effective date of termination stated in the notice, terminate all existing subcontracts and purchase orders and enter into no further subcontracts and purchase orders.

§ 14.4.3 In case of such termination for the Owner's convenience, the Owner shall pay the Contractor for Work properly executed; costs incurred by reason of the termination, including costs attributable to termination of Subcontracts; and the termination fee, if any, set forth in the Agreement.

ARTICLE 15 CLAIMS AND DISPUTES

§ 15.1 Claims

§ 15.1.1 Definition

A Claim is a demand or assertion by one of the parties seeking, as a matter of right, payment of money, a change in the Contract Time, or other relief with respect to the terms of the Contract. The term "Claim" also includes other disputes and matters in question between the Owner and Contractor arising out of or relating to the Contract. The responsibility to substantiate Claims shall rest with the party making the Claim. This Section 15.1.1 does not require the Owner to file a Claim in order to impose liquidated damages in accordance with the Contract Documents.

§ 15.1.2 Time Limits on Claims

The Owner and Contractor shall commence all Claims and causes of action against the other and arising out of or related to the Contract, whether in contract, tort, breach of warranty or otherwise, in accordance with the requirements of the binding dispute resolution method selected in the Agreement and within the period specified by applicable law, but in any case not more than 10 years after the date of Substantial Completion of the Work. The Owner and Contractor waive all Claims and causes of action not commenced in accordance with this Section 15.1.2.

§ 15.1.3 Notice of Claims

§ 15.1.3.1 Claims by either the Owner or Contractor, where the condition giving rise to the Claim is first discovered prior to expiration of the period for correction of the Work set forth in Section 12.2.2, shall be initiated by notice to the other party and to the Initial Decision Maker with a copy sent to the Architect, if the Architect is not serving as the Initial Decision Maker. Claims by either party under this Section 15.1.3.1 shall be initiated within 21 days after occurrence of the event giving rise to such Claim or within 21 days after the claimant first recognizes the condition giving rise to the Claim, whichever is later.

§ 15.1.3.2 Claims by either the Owner or Contractor, where the condition giving rise to the Claim is first discovered after expiration of the period for correction of the Work set forth in Section 12.2.2, shall be initiated by notice to the other party. In such event, no decision by the Initial Decision Maker is required.

§ 15.1.4 Continuing Contract Performance

§ 15.1.4.1 Pending final resolution of a Claim, except as otherwise agreed in writing or as provided in Section 9.7 and Article 14, the Contractor shall proceed diligently with performance of the Contract and the Owner shall continue to make payments in accordance with the Contract Documents.

§ 15.1.4.2 The Contract Sum and Contract Time shall be adjusted in accordance with the Initial Decision Maker's decision, subject to the right of either party to proceed in accordance with this Article 15. The Architect will issue Certificates for Payment in accordance with the decision of the Initial Decision Maker.

§ 15.1.5 Claims for Additional Cost

If the Contractor wishes to make a Claim for an increase in the Contract Sum, notice as provided in Section 15.1.3 shall be given before proceeding to execute the portion of the Work that is the subject of the Claim. Prior notice is not required for Claims relating to an emergency endangering life or property arising under Section 10.4.

§ 15.1.6 Claims for Additional Time

§ 15.1.6.1 If the Contractor wishes to make a Claim for an increase in the Contract Time, notice as provided in Section 15.1.3 shall be given. The Contractor's Claim shall include an estimate of cost and of probable effect of delay on progress of the Work. In the case of a continuing delay, only one Claim is necessary.

§ 15.1.6.2 If adverse weather conditions are the basis for a Claim for additional time, such Claim shall be documented by data substantiating that weather conditions were abnormal for the period of time, could not have been reasonably anticipated, and had an adverse effect on the scheduled construction.

§ 15.1.7 Waiver of Claims for Consequential Damages

The Contractor and Owner waive Claims against each other for consequential damages arising out of or relating to this Contract. This mutual waiver includes

.1 damages incurred by the Owner for rental expenses, for losses of use, income, profit, financing, business and reputation, and for loss of management or employee productivity or of the services of such persons; and

.2 damages incurred by the Contractor for principal office expenses including the compensation of personnel stationed there, for losses of financing, business and reputation, and for loss of profit, except anticipated profit arising directly from the Work.

This mutual waiver is applicable, without limitation, to all consequential damages due to either party's termination in accordance with Article 14. Nothing contained in this Section 15.1.7 shall be deemed to preclude assessment of liquidated damages, when applicable, in accordance with the requirements of the Contract Documents.

§ 15.2 Initial Decision

§ 15.2.1 Claims, excluding those where the condition giving rise to the Claim is first discovered after expiration of the period for correction of the Work set forth in Section 12.2.2 or arising under Sections 10.3, 10.4, and 11.5, shall be referred to the Initial Decision Maker for initial decision. The Architect will serve as the Initial Decision Maker, unless otherwise indicated in the Agreement. Except for those Claims excluded by this Section 15.2.1, an initial decision shall be required as a condition precedent to mediation of any Claim. If an initial decision has not been rendered within 30 days after the Claim has been referred to the Initial Decision Maker, the party asserting the Claim may demand mediation and binding dispute resolution without a decision having been rendered. Unless the Initial Decision Maker and all affected parties agree, the Initial Decision Maker will not decide disputes between the Contractor and persons or entities other than the Owner.

§ 15.2.2 The Initial Decision Maker will review Claims and within ten days of the receipt of a Claim take one or more of the following actions: (1) request additional supporting data from the claimant or a response with supporting data from the other party, (2) reject the Claim in whole or in part, (3) approve the Claim, (4) suggest a compromise, or (5) advise the parties that the Initial Decision Maker is unable to resolve the Claim if the Initial Decision Maker lacks sufficient information to evaluate the merits of the Claim or if the Initial Decision Maker concludes that, in the Initial Decision Maker's sole discretion, it would be inappropriate for the Initial Decision Maker to resolve the Claim.

§ 15.2.3 In evaluating Claims, the Initial Decision Maker may, but shall not be obligated to, consult with or seek information from either party or from persons with special knowledge or expertise who may assist the Initial Decision Maker in rendering a decision. The Initial Decision Maker may request the Owner to authorize retention of such persons at the Owner's expense.

§ 15.2.4 If the Initial Decision Maker requests a party to provide a response to a Claim or to furnish additional supporting data, such party shall respond, within ten days after receipt of the request, and shall either (1) provide a response on the requested supporting data, (2) advise the Initial Decision Maker when the response or supporting data will be furnished, or (3) advise the Initial Decision Maker that no supporting data will be furnished. Upon receipt of the response or supporting data, if any, the Initial Decision Maker will either reject or approve the Claim in whole or in part.

§ 15.2.5 The Initial Decision Maker will render an initial decision approving or rejecting the Claim, or indicating that the Initial Decision Maker is unable to resolve the Claim. This initial decision shall (1) be in writing; (2) state the reasons therefor; and (3) notify the parties and the Architect, if the Architect is not serving as the Initial Decision Maker, of any change in the Contract Sum or Contract Time or both. The initial decision shall be final and binding on the parties but subject to mediation and, if the parties fail to resolve their dispute through mediation, to binding dispute resolution.

§ 15.2.6 Either party may file for mediation of an initial decision at any time, subject to the terms of Section 15.2.6.1.

§ 15.2.6.1 Either party may, within 30 days from the date of receipt of an initial decision, demand in writing that the other party file for mediation. If such a demand is made and the party receiving the demand fails to file for mediation within 30 days after receipt thereof, then both parties waive their rights to mediate or pursue binding dispute resolution proceedings with respect to the initial decision.

§ 15.2.7 In the event of a Claim against the Contractor, the Owner may, but is not obligated to, notify the surety, if any, of the nature and amount of the Claim. If the Claim relates to a possibility of a Contractor's default, the Owner may, but is not obligated to, notify the surety and request the surety's assistance in resolving the controversy.

§ 15.2.8 If a Claim relates to or is the subject of a mechanic's lien, the party asserting such Claim may proceed in accordance with applicable law to comply with the lien notice or filing deadlines.

§ 15.3 Mediation

§ 15.3.1 Claims, disputes, or other matters in controversy arising out of or related to the Contract, except those waived as provided for in Sections 9.10.4, 9.10.5, and 15.1.7, shall be subject to mediation as a condition precedent to binding dispute resolution.

§ 15.3.2 The parties shall endeavor to resolve their Claims by mediation which, unless the parties mutually agree otherwise, shall be administered by the American Arbitration Association in accordance with its Construction Industry Mediation Procedures in effect on the date of the Agreement. A request for mediation shall be made in writing, delivered to the other party to the Contract, and filed with the person or entity administering the mediation. The request may be made concurrently with the filing of binding dispute resolution proceedings but, in such event, mediation shall proceed in advance of binding dispute resolution proceedings, which shall be stayed pending mediation for a period of 60 days from the date of filing, unless stayed for a longer period by agreement of the parties or court order. If an arbitration is stayed pursuant to this Section 15.3.2, the parties may nonetheless proceed to the selection of the arbitrator(s) and agree upon a schedule for later proceedings.

§ 15.3.3 Either party may, within 30 days from the date that mediation has been concluded without resolution of the dispute or 60 days after mediation has been demanded without resolution of the dispute, demand in writing that the other party file for binding dispute resolution. If such a demand is made and the party receiving the demand fails to file for binding dispute resolution within 60 days after receipt thereof, then both parties waive their rights to binding dispute resolution proceedings with respect to the initial decision.

§ 15.3.4 The parties shall share the mediator's fee and any filing fees equally. The mediation shall be held in the place where the Project is located, unless another location is mutually agreed upon. Agreements reached in mediation shall be enforceable as settlement agreements in any court having jurisdiction thereof.

§ 15.4 Arbitration

§ 15.4.1 If the parties have selected arbitration as the method for binding dispute resolution in the Agreement, any Claim subject to, but not resolved by, mediation shall be subject to arbitration which, unless the parties mutually agree otherwise, shall be administered by the American Arbitration Association in accordance with its Construction Industry Arbitration Rules in effect on the date of the Agreement. The Arbitration shall be conducted in the place where the Project is located, unless another location is mutually agreed upon. A demand for arbitration shall be made in writing, delivered to the other party to the Contract, and filed with the person or entity administering the arbitration. The party filing a notice of demand for arbitration must assert in the demand all Claims then known to that party on which arbitration is permitted to be demanded.

§ 15.4.1.1 A demand for arbitration shall be made no earlier than concurrently with the filing of a request for mediation, but in no event shall it be made after the date when the institution of legal or equitable proceedings based on the Claim would be barred by the applicable statute of limitations. For statute of limitations purposes, receipt of a written demand for arbitration by the person or entity administering the arbitration shall constitute the institution of legal or equitable proceedings based on the Claim.

§ 15.4.2 The award rendered by the arbitrator or arbitrators shall be final, and judgment may be entered upon it in accordance with applicable law in any court having jurisdiction thereof.

§ 15.4.3 The foregoing agreement to arbitrate and other agreements to arbitrate with an additional person or entity duly consented to by parties to the Agreement, shall be specifically enforceable under applicable law in any court having jurisdiction thereof.

§ 15.4.4 Consolidation or Joinder

§ 15.4.4.1 Subject to the rules of the American Arbitration Association or other applicable arbitration rules, either party may consolidate an arbitration conducted under this Agreement with any other arbitration to which it is a party provided that (1) the arbitration agreement governing the other arbitration permits consolidation, (2) the arbitrations to be consolidated substantially involve common questions of law or fact, and (3) the arbitrations employ materially similar procedural rules and methods for selecting arbitrator(s).

§ 15.4.4.2 Subject to the rules of the American Arbitration Association or other applicable arbitration rules, either party may include by joinder persons or entities substantially involved in a common question of law or fact whose presence is required if complete relief is to be accorded in arbitration, provided that the party sought to be joined consents in writing to such joinder. Consent to arbitration involving an additional person or entity shall not constitute consent to arbitration of any claim, dispute or other matter in question not described in the written consent.

§ 15.4.4.3 The Owner and Contractor grant to any person or entity made a party to an arbitration conducted under this Section 15.4, whether by joinder or consolidation, the same rights of joinder and consolidation as those of the Owner and Contractor under this Agreement.

Additions and Deletions Report for

AIA® Document A201® – 2017

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

Note: This Additions and Deletions Report is provided for information purposes only and is not incorporated into or constitute any part of the associated AIA document. This Additions and Deletions Report and its associated document were generated simultaneously by AIA software at 13:48:19 ET on 01/09/2025.

PAGE 1

Klein ISD – Schindewolf Gym Addition
20903 Ella Boulevard
Spring, TX 77388

...

Klein Independent School District
7200 Spring Cypress Rd.
Klein, TX 77379

...

(Name, legal status and address)

DLR Group inc. of Texas, a Texas corporation
1000 Louisiana Street
Suite 1100
Houstin, TX 77002

Certification of Document's Authenticity

AIA® Document D401™ – 2003

I, , hereby certify, to the best of my knowledge, information and belief, that I created the attached final document simultaneously with its associated Additions and Deletions Report and this certification at 13:48:19 ET on 01/09/2025 under Order No. 3104241897 from AIA Contract Documents software and that in preparing the attached final document I made no changes to the original text of AIA® Document A201™ – 2017, General Conditions of the Contract for Construction, other than those additions and deletions shown in the associated Additions and Deletions Report.

_____

(Signed)

_____

(Title)

_____

(Dated)

DOCUMENT 007300A - KLEIN ISD SUPPLEMENTARY CONDITIONS TO THE AIA DOCUMENT A201-2017 GENERAL CONDITIONS OF THE CONTRACT FOR CONSTRUCTION

The following supplements modify the "General Conditions of the Contract for Construction", AIA Document A201, Sixteenth Edition, 2017. Where a portion of the General Conditions is modified or deleted by these Supplementary Conditions, the unaltered portions of the General Conditions shall remain in effect. As appropriate, for purposes of this Request for Proposal, the term "Bid" shall mean "Proposal" and the term "Bidder" shall mean "Offeror", wherever they appear in the Construction Documents. The term "Contractor" shall include a Construction Manager-at-Risk.

ARTICLE 1 -- GENERAL PROVISIONS

1.1 BASIC DEFINITIONS

1.1.1 THE CONTRACT DOCUMENT

Delete Section **1.1.1** in its entirety and substitute the following:

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

To the extent any provision in the Supplementary Conditions to these AIA Document A201-2017 General Conditions, issued by Owner, conflicts with any provision in the Supplementary Conditions issued by the Architect; the Supplementary Conditions to these AIA Document A201-2017 General Conditions issued by Owner shall control.

1.1.3 THE WORK

Add the following sentence at the end of this section:

It also includes all supplies, skill, supervision, transportation services and other facilities and things necessary, proper or incidental to the carrying out and completion of the terms of the contract and all other items of cost or value needed to produce, construct and fully complete the public work identified by the Contract Documents.

1.2 CORRELATION AND INTENT OF THE CONTRACT DOCUMENTS

Add the following Sections:

1.2.1.2 Precedence of the Contract Documents: The most recently issued Document takes precedence over previous issues of the same Document. The order of precedence is as follows with the highest authority listed as "1".

.1 Contract Modifications (such as Change Orders) signed by the Contractor and Owner.

.2 The Agreement. (AIA Document A101-2017)

.3 The Supplementary Conditions

.4 The General Conditions of the Contract for Construction
.5 Addenda, with those of later date having precedence over those of earlier date
.6 Drawings and Specifications

Should these Documents disagree in themselves, the Architect and Owner will select the appropriate method for performing the Work, to facilitating avoiding increase in the Contract cost.

1.2.1.3 Relation of Specifications and Drawings: To be equivalent in authority and priority. Should they disagree in themselves, or with each other, prices shall be based on the most expensive combination of quality and quantity of Work indicated. In the event of the above mentioned disagreements, the resolution shall be determined by the Architect and Owner.

1.6 NOTICE

Delete the text of Section **1.6.1** in its entirety and substitute the following:

1.6.1 Written notice shall be deemed to have been duly served if delivered in person to the individual or a member of the firm or entity or to an officer at the corporation for which is was intended, or if delivered at or sent by certified mail, or by registered or certified mail, or by courier service providing proof of delivery, to the last business address known to the party giving notice, or if delivered by facsimile or other electronic communications to the offices of the person or corporation for which it was intended. For facsimiles or other electronic communications received after 5:00 p.m. on a business day, or on a weekend or legal holiday on which the recipient's offices are closed, notice shall be deemed to have been duly served on the next business day.

Delete the text of Section **1.6.2** in its entirety.

Add Section **1.9** as follows:

1.9 MISCELLANEOUS OTHER DEFINITIONS

1.9.1 ADDENDA, ADDENDUM

Documents issued by the Architect prior to execution of the Owner Contractor Agreement for this Project that modify or clarify the Proposal Documents. All addenda become a part of the Contract Documents.

1.9.2 ALTERNATE PROPOSAL(S)

A separate amount stated on a separate Proposal Form which, if accepted by the Owner, will be added to or deducted from the Base Proposal. If accepted, the work that corresponds to the alternate proposal will become part of the agreement between Owner and Contractor. Alternate proposals shall remain valid for the same period of time as the Base Proposal after receipt of proposals, regardless if an Owner Contractor Agreement has been executed, unless indicated otherwise herein.

1.9.3 APPROVED, APPROVED EQUIVALENT, APPROVED EQUAL, OR EQUAL

The terms Approved, Approved Equivalent, Approved Equal, and Or Equal, relate to the substitution of products or systems approved in writing by the Architect. Refer to Paragraph 3.4.2, Substitution of Products and Systems, for procedures which must be followed after award of contract. The substitution procedure process to be followed prior to receipt of proposals is described in the Instructions to Bidders.

1.9.4 BASE PROPOSAL

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

1.9.5 CONTRACT TIME

The period of time which is established in the Contract Documents for Substantial Completion of the Work. This period of time is subject to authorized adjustments as enumerated in the Contract Documents.

1.9.6 DATE OF AGREEMENT

The date the Owner formally awards a Contract for Construction of the Work. This date will be inserted in 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 Work.

1.9.7 DATE OF COMMENCEMENT OF THE WORK

The date of a written Notice to Proceed to the Contractor for a given portion of the Work. This date constitutes day zero (0) of the stated Contract Time. The Notice to Proceed will be issued after the District has received and validated the Contractor's Payment Bond, Performance Bond and Insurance.

1.9.8 DATE OF FINAL COMPLETION

The end of construction. See AIA Document A201, Section 9.10.

1.9.9 DAY

The following days are referenced in the documents:

.1 Calendar Days. Extensions of time granted for Regular Work Days lost, if any, will be converted to Calendar Days.

.2 Holidays: The days officially recognized by the construction industry in this area as a holiday; normally limited to the observance days of New Year's Day, Memorial Day, Fourth of July, Labor Day, Thanksgiving Day and the day after and Christmas Day.

.3 Regular Work Days: All calendar days except holidays, Saturdays, and Sundays. Requests for extensions of time shall be requested on the basis of Regular Work Days, and those days, if approved, will be converted to calendar days by multiplying by a factor of one and four-tenths (1.4).

.4 **No extensions of the Contract Time will be granted due to inclement weather, except as provided in Section 8.3.1.**

1.9.10 NOTICE TO PROCEED

A notice that may be given by the Owner to the Contractor that directs the Contractor to start the Work. It may also establish the Date of Commencement of the Work.

1.9.11 PROVIDE

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

1.9.12 PUNCH LIST

A comprehensive list prepared by the Contractor prior to Substantial Completion to establish all items to be completed or corrected; this list may be supplemented by the Architect or Owner. See AIA Document A201, Section 9.8.

1.9.13 UNIT PRICES

A cost for a unit of work as described in the Contract Documents. The Owner may add or deduct Unit Price work at the amounts stated on the Proposal Form and such amounts shall not be subject to additional mark up by the Contractor or his subcontractors."

ARTICLE 2 – OWNER

2.1 GENERAL

Delete the text of Section **2.1.1** in its entirety and substitute the following:

2.1.1 The Owner is the person or entity identified as such in the Agreement and is referred to throughout the Contract Documents as if singular in number. All parties understand that only the Board of Trustees for the Owner acting as a body corporate has the authority to bind the Owner with respect to all matters requiring the Board's approval under current policy of the Board of Trustees for the Owner, including, but not limited to, Change Orders. Except as otherwise provided in Section 4.2.1, the Architect does not have authority to bind the Owner with respect to matters requiring the Owner's approval or authorization. The term "Owner" means the Owner or the Owner's authorized representative.

Delete the text of Section **2.1.2** in its entirely.

2.2 EVIDENCE OF THE OWNER'S FINANCIAL ARRANGEMENTS

After the first sentence of Section **2.2.1,** delete the remainder of Section **2.2.1** in its entirety.

Delete Sections **2.2.2** and **2.2.3** in their entirety.

2.3 INFORMATION AND SERVICES REQUIRED OF THE OWNER

Delete Section **2.3.6** in its entirety and replace it with the following:

2.3.6 The Contractor will be furnished free of charge 25 copies of the Drawings and 25 copies of the Project Manual. These copies may have been used during the Bid/Proposal process and it is the Contractor's responsibility to determine their completeness and to request replacement of any missing portions. Additional new copies will be furnished at the cost of reproduction, postage, and handling.

2.5 OWNER'S RIGHT TO CARRY OUT THE WORK

Delete the text of Section **2.5.** in its entirety and substitute the following:

If the Contractor defaults or neglects to carry out the work in accordance with the Contract Documents and fails, after receipt of written notice from the Owner, to commence and continue correction of such default or neglect with diligence and promptness, the Owner may, without prejudice to other remedies the Owner may have, correct such deficiencies. In such case, an appropriate Change Order shall be issued deducting from payments then or thereafter due the Contractor the actual cost of correcting such deficiencies, including the Owner's expenses and compensation for the Architect's additional services and expenses made necessary by such default, neglect or failure. Such action by the Owner and amounts charged to the Contractor are both subject to the prior approval of the Architect. If payments then or thereafter due the Contractor are not sufficient to cover such amounts, the Contractor shall pay the difference to the Owner within thirty (30) days of receipt of written notice from the Owner therefor.

Add Section **2.6** as follows:

2.6 OWNER'S LACK OF LIABILITY TO THIRD PARTY

2.6.1 The Owner is not responsible for the acts and/or omissions of, or contractually involved with, any subcontractors, suppliers of labor or materials, and/or their respective employees or agents or any other third-party claimants. Such claimants shall not constitute third party beneficiaries under this contract. The Contractor and/or his Surety solely shall deal with, take responsibility for, and be liable to such parties under this Contract. Contractor will indemnify and defend the Owner from any legal actions against Owner for unpaid bills of subcontractors.

Add Section **2.7** as follows:

2.7 OWNER'S RIGHT TO OCCUPY THE PROJECT

2.7.1 The Owner shall have the right to occupy or use without prejudice to the right of either party, any completed or largely completed portions of the project, notwithstanding the time for completing the entire work or such portions may not yet have expired. Such occupancy and use shall not constitute acceptance of any work not in accordance with the Contract Documents. If the Contractor determines that said occupancy may cause a delay to the completion of the project, he shall notify the Owner in writing immediately.

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

2.7.3 If Contractor has not completed the obligations of the Contract Documents by the dates established by subsequent Amendments to the Agreement Between Owner and Construction Manager, the Owner shall have the right to occupy or use the entire project.

ARTICLE 3 -- CONTRACTOR

3.1 GENERAL

Add Section **3.1.4** as follows:

3.1.4 The Contractor must be fully qualified under any state or local licensing laws for Contractors in effect at the time and at the location of the work. The Contractor is responsible for determining that all of his subcontractors and prospective subcontractors are duly licensed in accordance with the law.

3.2 REVIEW OF CONTRACT DOCUMENTS AND FIELD CONDITIONS BY CONTRACTOR

Delete the last sentence of Section **3.2.4** in its entirety and substitute the following:

If the Contractor performs those obligations, the Contractor shall not be liable to the Owner or architect for damages resulting from errors, inconsistencies or omissions in the Contract Documents, for differences between field measurements or conditions and the Contract Documents, or for nonconformities of the Contract Documents to applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities provided such errors, inconsistencies, omissions, differences, or nonconformities could not have been ascertained from a careful study of the Contract Documents.

Add Sections **3.2.5, 3.2.**6 and **3.2.7** as follows:

3.2.5 The Contractor shall make a reasonable attempt to interpret the Contract Documents before asking the Architect for assistance in interpretation. The Contractor shall not ask the Architect for observation of work prior to the Contractor's field superintendent's personal inspection of the work and his determination that the work of all major subcontractors, to allow the subcontractor to demonstrate his understanding of the documents to the Architect and to allow the subcontractor to ask for any interpretation he may require.

3.2.6 If, in the opinion of the Architect, the Contractor does not make a reasonable effort to comply with the above requirements of the Contract Documents and this causes the Architect or his Consultants to expend an unreasonable amount of time in the discharge of the duties imposed on him by the Contract Documents, then the Contractor shall bear the cost of compensation for the Architect's additional services made necessary by such failure. The Architect will give the Contractor prior notice of intent to bill for additional services related to Sections 3.2.5, 3.2.6 and 3.7 before additional services are performed.

3.2.7 If the Contractor has knowledge that any of the products or systems specified will perform in a manner that will limit the Contractor's ability to satisfactorily perform the work or to honor his Warranty, he shall promptly notify the Architect in writing, providing substantiation for his position. Any necessary changes, including substitutions of materials, shall be accomplished by appropriate Modification.

3.3 SUPERVISION AND CONSTRUCTION PROCEDURES

Delete the last sentence of Section **3.3.1** in its entirety and substitute the following:

If the Contractor is then instructed to proceed with the required means, methods, techniques, sequences or procedures without acceptance of changes proposed by the Contractor, the Owner shall be solely responsible for any resulting loss or damage arising solely from those Owner-required means, methods, techniques, sequences or procedures, but only to the extent the Owner would be responsible for any such losses or damages under state and/or federal law.

Add Sections **3.3.4** and **3.3.5** as follows:

3.3.4 The Contractor is especially cautioned to coordinate the routing of mechanical and electrical items prior to commencing these operations.

3.3.5 Contractor shall bear sole responsibilities for design and execution of acceptable trenching and shoring procedures, in accordance with Texas Government Code, Section 2166.303 and Texas Health and Safety Code, Subchapter C, Sections 756.021, et seq. On trench excavations in excess of 5 feet in depth, Contractor shall pay a qualified engineer, experienced in the engineering design and preparation of drawings and specifications for compliance with state requirements for trenching and shoring, to prepare and professionally seal detailed drawings and specifications directing Contractor in the safe execution of trenching and shoring.

3.3.6 Any time that the Contractors' employees, subcontractors and their agents and employees, and other persons or entities performing portions of the work for or on behalf of the Contractor or any of its subcontractors are on site, the work shall be supervised by a qualified employee of the Contractor.

3.4 LABOR AND MATERIALS

Delete Section **3.4.2** in its entirety and replace it with the following:

3.4.2 The materials, products, and the systems covered by these specifications have been selected as a standard because of quality, particular suitability, or record of satisfactory performance. It is not intended to preclude the use of equivalent or better materials, products, or systems provided that same meets the requirements of the particular project and have been approved in an addendum as a substitution prior to the submission of bids. If prior written approval in an addendum has not been obtained, it will be assumed that the Bid is based upon the materials, products, and systems described in the Bidding Documents and no substitutions will be permitted, except as provided hereinafter.

.1 If, after award of contract, the Contractor of one of his Subcontractors, or Suppliers determines that any of the products or systems specified will perform in a manner that will limit the Contractor's ability to satisfactorily perform the work or to honor the Warranty, the Contractor shall promptly notify the Architect, in writing, providing detailed substantiation for his position. Any changes deemed necessary by the Owner and Architect, including substitution of materials and change in Contract Sum, either upward or downward, if any, shall be accompanied by appropriate Modification.

.2 After the Contract has been executed, the Owner and Architect will consider a formal request for the substitution of products on the Work in place of those specified only under the conditions set forth in specification referring to Product Options and Substitutions.

.3 Requests for substitution, received by the Architect later than forty five (45) days after "Notice to Proceed" or "Date of Commencement of the Work" (whichever occurs first), may result in additional costs to the Owner. Contractor agrees to reimburse the Owner through deductive Change Order to the Contract, for all costs associated with such requests.

.4 By making request for substitutions based on Subparagraph 3.4.2 above, the Contractor

.1 represents that the Contractor has personally investigated the proposed substitute product and determined that it is equivalent or superior in all respects to that specified, and is suitable for the intended purpose;

.2 represents that the Contractor will provide the same warranty for the substitution that the Contractor would for that specified;

.3 certifies that the cost data presented is complete and includes all related costs under this Contract except the Architect's redesign costs, and waives all claims for additional costs related to the substitution which subsequently become apparent; and

.4 will coordinate the installation of the accepted substitute, making such changes as may be required for the Work to be complete in all respects.

.5 Substitution requests shall be submitted on the forms included herein and in accordance with the process established in specification referring to Product Options and Substitutions.

Add the following Sections after Section **3.4.3**

3.4.3 **.1** State law prohibits possession and/or use of alcohol and tobacco products on school property at all times.

.2 State law prohibits weapons or firearms on school property.

.3 There shall be zero tolerance for fraternization with students, teachers and any other school district personnel, Contractor will immediately remove any employee that violates this provision from the project.

.4 No glass bottles shall be brought on the construction site or Owner's property by any construction personnel.

3.5 WARRANTY

Delete the text of Section 3.5.1 in its entirety and substitute the following:

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

Add Sections **3.5.3, 3.5.4** and **3.5.5** as follows:

3.5.3 In the event of failure in the Work, including a specified product, whether during construction, or the correction period (which shall be one (1) year from the Date of Substantial Completion, except where a longer period as specified), the Contractor shall take prompt and appropriate measures to assure correction or replacement of the defective Work or any portion thereof, including manufactured products, whether notified by the Owner or the Architect. Upon correction of warranty items, the Contractor shall provide the Owner and Architect with written notification of said correction. This obligation shall survive acceptance of the Work under the Construction Contract.

3.5.4 The Contractual Correction Period for this Project is one (1) year from the date of Substantial Completion, except for any extended warranties as specified within the Contract Documents. Items of Work not completed until after the deadline for Substantial Completions shall have their warranties (general and any extended warranty periods) extended by the period of time between the deadline for Substantial Completion and the actual completion of the Work. Such warranties shall be submitted to the Owner in writing, documenting such time extensions. This correction period shall not restrict or modify extended warranties called for or provided on systems, equipment or other specific portions of the Work.

3.5.5 The Contractor shall accompany the Owner and Architect for a complete reinspection of the Project approximately eleven (11) months after the Date of Substantial Completion and shall promptly complete any observed or reported deficiencies in the Work, including any uncompleted Punch List items or outstanding and incomplete warranty items. The contractor shall provide written notification to the Owner and Architect when said Punch List items and/or additional deficiencies observed have been corrected. This obligation shall survive acceptance of the Work under the Construction Contract.

3.6 TAXES

Delete Section **3.6** in its entirety and substitute the following:

The Owner qualifies for exemption from State and Local Sales and Use Taxes pursuant to the provision of Article 20.04(f) of the Texas Limited Sales, Excise and Use Tax Act. Taxes normally levied on the purchase, rental and lease of materials, supplies and equipment used or consumed in performance of the Contract may be exempted by issuing to suppliers an exemption certificate in lieu of tax. Exemption certificates comply with State Comptroller of Public Accounts Ruling No. 95-0.07. Any such exemption certificate issued in lieu of tax shall be subject to State Comptroller of Public Accounts Ruling No. 95-0.09, as amended. Failure by the Contractor or Subcontractors to take advantage of the Owner's exemption and to obtain such exemption certificate shall make him responsible for paying taxes incurred on materials furnished on the Project without additional cost to or reimbursement by the Owner.

3.7 PERMITS, FEES, NOTICES AND COMPLIANCES WITH LAWS

After Section **3.7.1**, add the following Sections:

3.7.1 **.1** The Owner shall pay directly to the governing authority the cost of all permanent property utility assessments and similar utility connection charges.

.2 The Contractor shall pay directly all temporary utility charges (excluding permanent power), utility district/company inspection fees, temporary tap charges, and temporary water meter charges and any other similar fees assessed by jurisdictional authority having control over this Project. The Contractor shall secure and pay for all governing authorities' permit fees.

.3 Fees payable to the Texas Department of Licensing and Regulation (TDLR) for document review relative to the Elimination of Architectural Barriers Act shall be paid by the Owner and the Architect will submit the documents to the TDLR for review and approval.

.4 The Contractor shall pay for all measures required for the SWPPP.

3.8 ALLOWANCES

Delete Section **3.8** in its entirety and substitute the following:

3.8.1 The Contractor shall include in the Contract Sum all allowances stated in the Contract documents. Items covered by allowances shall be supplied for such amounts and by such persons or entities as the Owner may direct and approve in writing. All unused allowance amounts shall be credited back to Owner, along with any markups included in the Contract Sum on such unused amounts.

3.9 SUPERINTENDENT

Delete Section 3.9.1 in its entirety and substitute the following:

3.9.1 The Contractor shall employ a competent superintendent, project manager and necessary assistants who shall be in attendance at the Project site during performance of the Work, including Punch List work. The superintendent and project manager shall represent the Contractor, and unless provided otherwise in Section 3.1.1, communications given to the superintendent or project manager shall be binding as if given to the Contractor.

3.10 CONTRACTOR'S CONSTRUCTION AND SUBMITTAL SCHEDULES

Delete Section **3.10.1** and substitute the following:

3.10.1 Within 30 days of being awarded an Amendment, the Contractor shall prepare and submit for the Owner and Architect's review, a construction schedule for the Work, with critical path clearly defined. The schedule shall not exceed time limits current under the Contract Documents. For further schedule requirements refer to specification section regarding project schedules in the Project Manual.

Add the following clause to Section **3.10.2**:

3.10.2 Requirements for the submittal schedule are outlined in the specifications. If the Contractor fails to submit a submittal schedule or fails to provide submittals in accordance with the approved submittal schedule, the Contractor shall not be entitled to any increase in the Contract Sum or extension of the Contract Time based on the time required for review of submittals.

Add Section **3.10.4** as follows:

3.10.4 The Contractor shall submit to the Architect, with each monthly Application for Payment; a copy of the progress schedule updated to reflect the current status of the project. The Contractor shall take whatever action necessary to assure that the project completion schedule is met.

3.11 DOCUMENTS AND SAMPLES AT THE SITE

Add Section **3.11.1** as follows:

3.11.1 The Contractor shall post all Addenda on Construction Documents prior to commencing work in the site.

3.12 SHOP DRAWINGS, PRODUCT DATA AND SAMPLES

At Section **3.12.5**, add the following Sections:

3.12.5 .1 If, in the opinion of the Architect, the Shop Drawings, Product Data, Samples and similar submittals are incomplete, indicate an inadequate understanding of the work covered by the submittals, or indicate a lack of study and review by the Contractor prior to submittal to the Architect, the submittals will be returned, unchecked, to the Contractor for correction of these three deficiencies and subsequent resubmittal. Additional service charges as outlined in 3.2.6 may be charged by the Architect in this event.

.2 The Architect will take no action on Shop Drawings, Product Data, and Samples that have not first been certified, by stamped, signed notation, as having been checked and approved by the Contractor for use in the Work, or that are not specifically required by the Contract Documents.

At Section **3.12.7**, correct the word "approved" in the last line to read "accepted".

At Section **3.12.8**, correct "Architect's approval" in the last line to read "Architect's acceptance".

At Section **3.12.9**, correct "Architect's approval" in the last line to read "Architect's acceptance" and add the following Section:

3.12.9.1 Deviation from the requirements of the Contract Documents indicated on shop Drawings, Product Data, and Samples, does not constitute the required notification "in writing.

Add Sections **3.12.11** and **3.12.12** as follows:

3.12.11 The Contractor shall submit complete Shop Drawings, Product Data, Samples and similar submittals required by the Contract Documents to the Architect at least thirty (30) days prior to the date the Contractor needs the reviewed submittals returned. Where colors are to be selected by the Architect, submit all 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 four weeks of the date of the contact for construction.

3.12.12 The Contractor shall submit digital PDF's of Shop Drawings, Product Data, and similar submittals in the proper format according to the procedures stipulated within the Contract Documents. Digitally submitted Shop Drawings will be reviewed and marked by the Architect and/or his consultants and returned to the Contractor for his use, distribution, correction or resubmittal as required. Contractor corrections or revisions shall be resubmitted to the Architect in accordance with same procedures. The digitally marked up prints will be retained by the Architect and his consultants. Samples shall be submitted directly to the Architect for review.

Add Section 3**.12.13** as follows:

3.12.13 The Contractor shall provide MEP coordination drawings within a schedule mutually agreed upon by the Team and prior to installing the Work, showing how all piping, ductwork, lights, conduit, equipment, etc. will fit into the ceiling space allotted, including clearances required by the manufacturer, by code, or in keeping with good construction practice. Space for all trade elements must be considered on the same drawing. Drawings shall be at ¼ inch per foot minimum scale and shall include invert elevations and sections required to meeting intended purpose. The Contractor may propose an alternate method of accomplishing MEP coordination. If the alternate method is approved by the Team, it may be utilized.

3.14 CUTTING AND PATCHING

Add Section **3.14.3** as follows:

3.14.3 Leave all chases, holes and openings, straight and true, of proper size, and cut them into existing work as may be necessary for the proper installation of the work. Consult with all Subcontractors concerned, regarding proper locations and size. In case of conflict between requirement for cutting and patching and any other requirement of the Work, submit request for direction before proceeding with the Work. In case of failure to leave or cut them in the proper place, openings shall be cut afterward at no expense to the Owner. No excessive cutting will be permitted, nor shall any piers or other structural members be cut without prior approval. After such work has been installed, satisfactorily and carefully fit around, close up, repair, patch, and point up all cuts. Work shall be done with proper tools by workmen of the particular trade to which work belongs and shall be done without extra expense to the Owner. No description of specific cutting, patching, digging, etc., required for the work under a Specification Section that may be required for the proper accommodation of that work to the work of other trades shall relieve the Contractor from responsibility described above.

3.15 CLEANING UP

Add Section **3.15.3** as follows:

3.15.3 Prior to the Architect's inspection for Substantial Completion the Contractor shall clean exterior and interior surfaces exposed to view; remove temporary labels, stains, and foreign substances; polish transparent and glossy surfaces; clean equipment and fixtures to a sanitary condition; replace air filters in mechanical equipment; clean roof, gutters, and downspouts; remove obstructions and flush debris from drainage systems; clean site; sweep paved areas and rake clean other surfaces; remove trash and surplus materials from the site.

3.18 INDEMNIFICATION

Delete Sections **3.18.1** and **3.18.2** in their entirety and replace them with the following:

3.18.1 TO THE FULLEST EXTENT PERMITTED BY LAW, CONTRACTOR SHALL INDEMNIFY DEFEND AND HOLD HARMLESS THE OWNER AND ITS TRUSTEES, OFFICERS, AGENTS, AND EMPLOYEES (COLLECTIVELY, THE "INDEMNIFIED PARTIES") FROM AND AGAINST ALL CLAIMS, LOSSES, EXPENSES, COSTS, DEMANDS, SUITS, CAUSES OF ACTION, AND DAMAGES, INCLUDING WITHOUT LIMITATION, ATTORNEYS' FEES AND EXPENSES, ATTRIBUTABLE TO BODILY INJURY, SICKNESS, DISEASE OR DEATH OF ANY EMPLOYEE OF CONTRACTOR, ITS AGENTS, OR ITS SUBCONTRACTORS OF EVERY TIER, EVEN IF THE BODILY INJURY, SICKNESS, DISEASE OR DEATH IS CAUSED BY OR ALLEGED TO HAVE BEEN CAUSED BY THE NEGLIGENCE, FAULT OR STRICT LIABILITY OF ANY OF THE INDEMNIFIED PARTIES.

FOR ALL CLAIMS NOT ADDRESSED IN THE ABOVE PARAGRAPH, CONTRACTOR SHALL INDEMNIFY, DEFEND AND HOLD HARMLESS THE OWNER AND ITS TRUSTEES, OFFICERS, AGENTS, AND EMPLOYEES AND (COLLECTIVELY, THE "INDEMNIFIED PARTIES"), FROM AND AGAINST ALL CLAIMS, LOSSES, EXPENSES, COSTS, DEMANDS, SUITS, CAUSES OF ACTION, AND DAMAGES, INCLUDING WITHOUT LIMITATION, ATTORNEYS' FEES AND EXPENSES, OF ANY NATURE WHATSOEVER ARISING OUT OF OR RELATED TO THIS AGREEMENT OR THE WORK TO BE PERFORMED UNDER THIS AGREEMENT, BUT ONLY TO THE EXTENT OF THE NEGLIGENCE OR OTHER FAULT OF THE CONTRACTOR, ITS AGENTS, REPRESENTATIVES, EMPLOYEES OR SUBCONTRACTORS OF ANY TIER.

3.18.2 It is understood and agreed that Subparagraph 3.18 above is subject to, and expressly limited by, the terms and conditions of TEX. CIV. PRACT. & REM. CODE ANN. 130.001-130.005 (Vernon Supp. 1989), as amended or modified, or any successor statute. Contractor shall not be obligated under Subparagraph 3.18 to indemnify or hold harmless Architect or any agent, servant of employee of Architect from liability or damage that is caused by or results from:

.1 defects in plans, designs or specifications prepared, approved or used by the Architect; or

.2 negligence of the Architect in the rendition or conduct of professional duties called for or arising out of the Contract Documents and the plans, designs or specifications that are a part of the Contract Documents; and arises from:
- **.1** personal injury or death;
- **.2** property injury; or
- **.3** any other expense that arises from personal injury, death or property injury.

Add Section **3.18.3** as follows:

3.18.3 It is agreed with respect to any legal limitations, now or hereafter in effect and affecting the validity or enforceability of the indemnification obligation under Paragraph 3.18, such legal limitations are made a part of the indemnification obligation and shall operate to amend the indemnification obligation to the minimum extent necessary to bring the provision into conformity with the requirements of such limitations, and as so modified, the indemnification obligation shall continue in full force and effect.

Add Sections **3.19**, **3.20,** and **3.21** as follows:

3.19 RECORD DRAWINGS

3.19.1 Refer Owner's Closeout Procedures

3.20 PREVAILING WAGE RATES

3.20.1 As required by Chapter 2258 of the Texas Government Code Title 10 Prevailing Wage Rate, no employee used in this construction may be paid less than the minimum prevailing wage rate in effect for the Owner.

3.20.2 The Contractor and each Subcontractor and Sub-subcontractor shall pay to all laborers, workmen, and mechanics employed in execution of this Contract not less than rates set forth by law for each craft of type of workman or mechanic needed to execute this Contract.

3.20.3 Determination of prevailing wages shall not be construed to prohibit payment of more than the rates identified.

3.21 ANTITRUST VIOLATIONS

3.21.1 Contractor hereby assigns to Owner any and all claims for overcharges associated with this Contract which arise under the antitrust laws of the United States, 15 U.S.C.A. Section 1 et.seq. (1973). The Contractor shall include this provision in his contracts with each Subcontractor and Supplier. Each Subcontractor shall include such provision in contracts with Sub-subcontractors and suppliers.

3.22 THIRD-PARTY BENEFICIARY

3.22.1 No person or entity shall be deemed to be a third-party beneficiary of any provision(s) of this Contract; nor shall any provision(s) hereof be interpreted to create a right of action or otherwise permit anyone not a signatory party to the Contract to maintain an action for personal injury or property damage.

ARTICLE 4 – ARCHITECT

4.2 Administration of the Contract

Delete Section **4.2.2** in its entirety and substitute the following:

4.2.2 The Architect, as a representative of the Owner, will visit the site at intervals appropriate to the stage of the Contractor's operations (1) to become generally familiar with and to keep the Owner informed about the progress and quality of the portion of the Work completed, (2) to endeavor to guard the Owner against defects and deficiencies in the work, and (3) to determine in general if the work is being performed in a manner indicating that the work, when fully completed, will be in accordance with the Contract documents. The Architect will be required to make on-site inspections as necessary to keep the Owner informed of the progress of the Work and as necessary to guard the Owner against defects and deficiencies in the Work. The Architect will neither have control over or charge of, no be responsible for, the construction means, methods, techniques, sequences or procedures, or for the safety precautions and programs in connection with the Work, since these are solely the Contractor's rights and responsibilities under the Contract Documents, except as provided in Section 3.3.1.

Delete Section **4.2.6** in its entirety and substitute the following:

4.2.6 The Architect shall have authority to reject Work that does not conform to the Contract Documents. The Architect shall be required to promptly notify the Owner of any non-conforming Work and shall reject such non-conforming Work unless the Owner objects to the rejection in writing within twenty-four (24) hours of such notification. Whenever the Architect considers it necessary or advisable for implementation of the intent of the Contract documents, the Architect will have authority to require inspection or testing of the Work in accordance with the provisions of the Contract Documents, whether or not such Work is fabricated, installed or completed. Performance of any additional inspection or testing, which would result in additional cost to the Owner, shall require advance notice to and approval of the Owner. However, neither this authority of the Architect nor a decision made in good faith either to exercise or not to exercise such authority shall give rise to a duty or responsibility of the Architect to the Contractor, Subcontractors, material and equipment suppliers, their agents or employees, or other persons or entities performing portions of the Work, except when the Contractor's inability to perform the Work is a result of design flaw, error or omission.

Add the following Section **4.2.8.1**:

4.2.8.1 Allowance Expenditure will be authorized using Allowance Expenditure authorizations (AEA) executed by the Owner, the Architect and the Contractor. All Allowance Expenditure Authorizations will be incorporated into the contract by Change Order at the completion of the project. Work authorized by an AEA may be invoiced as it is completed.

Delete Section **4.2.13** in its entirety and substitute the following:

4.2.13 All decisions on matters relating to aesthetic effect shall initially be made by the Architect; however, all such decisions are subject to the Owner's written approval.

ARTICLE 5 – SUBCONTRACTORS

5.1 DEFINITIONS

At the end of Section **5.1.1** add the following sentence:

Wherever relevant, the term "Subcontractor" shall also include a person, or entity who supplies material or equipment for the Project.

At the end of Section **5.2.4**, add the following sentence:

Prior to such change the Contractor shall notify the Architect of his intent and reasons for such proposed changes.

5.4 CONTINGENT ASSIGNMENT OF SUBCONTRACTS

Delete the last sentence of Section **5.4.1** in its entirety and substitute the following:

When the Owner accepts the assignment of a subcontract agreement, the Owner assumes the Contractor's rights and obligations under the subcontract, but only to the extent permitted by law.

Delete the last sentence of Section **5.4.3** in its entirety.

ARTICLE 7 -- CHANGES IN THE WORK

7.1 GENERAL

Delete the text of Section **7.1.2** in its entirety and substitute the following:

7.1.2 A Change Order shall be based on agreement among the Owner, Contractor, and Architect, except when the Contract balance is amended as a result of Owner's Right to Carry out the Work under Section

2.4.1 or the Owner's assessment of liquidated damages as allowed by the Contract Documents. A Construction Change Directive requires agreement by the Owner or the Owner's representative and Architect, and may or may not be agreed to by the Contractor; an order for a minor change may be issued by the Architect alone.

Add Section **7.5** as follows:

7.5 ALLOWABLE MARKUPS FOR CHANGES IN THE WORK

7.5.1 Unless otherwise directed, the procedure and markup of the costs for additional work shall be determined in the following manner:

.1 Upon Change Proposal request, the Contractor shall quote the cost for changes in the work showing separately, credits and additional costs broken down by headings used in the Schedule of Values. Further breakdown into units of labor and materials may be required if agreement on cost cannot be reached using the breakdown by headings. The final cost shall be the amount of the Total Contract Value Change shown on the Change Proposal signed by the Contractor and Owner. For general construction work, not subcontracted, the Contractor shall consider as costs the actual invoice amount for additional materials, the sales tax on additional materials when applicable, the wages paid for additional direct labor, plus the Contractor's usual markup of wages to cover additional labor related costs such as insurance, taxes and fringe benefits.

.2 On changes executed within the Owner's Contingency Allowance, Contractor shall have included costs for combined overhead and profit, to the extent permitted by the Contract Documents, and General Conditions costs, including the cost of superintendents, field office expense, temporary facilities and services, small hand tools, construction equipment not specifically provided for the change in hand, home office expense, bond and building insurance premiums, and managing the Subcontractor's work, in his Base Contract amount. Allowed overhead and profit fee on Owner's Contingency Allowance changes to be included in the total cost to the Owner shall be based as follows:

.1 For each Subcontractor or Sub-subcontractor involved, for Work performed by that Subcontractor's of Sub-subcontractor's own forces, ten percent (10%) of the cost.

.2 For each Subcontractor, for Work performed by the Subcontractor's Sub-subcontractors, five percent (5%) of the amount due the Sub-subcontractors.

7.5.2 If any additional Work is authorized outside of or in excess of the Owner's Contingency Allowance, the combined overhead and profit for this work shall be based as follows:

.1 For the Contractor, for Work performed by the Contractor's own forces, a maximum total markup of ten percent (10%) of the actual cost on a lump sum project, or the Contractor's Construction Phase Fee on a Guaranteed Maximum Price Project.

.2 For Work performed by the Contractor's Subcontractor(s), five percent (5%) of the amount due the Subcontractor(s).

.3 For each Subcontractor or Sub-subcontractor involved, for work performed by that Subcontractor's or Sub-subcontractor's own forces, a maximum markup of ten percent (10%) of the actual cost.

.4 For each Subcontractor, for work performed by the Subcontractor's Sub-subcontractors, five percent (5%) of the amount due the Sub-subcontractor.

.5 Cost to which overhead and profit is to be applied shall be determined in accordance with Section 7.3.7.

7.5.3 In order to facilitate checking of quotations for extras or credits, all proposals, (except those so minor that their propriety can be seen by inspection), shall be accompanied by a complete and detailed itemization of costs including labor, materials, and Subcontracts. Labor and materials shall be itemized in the manner prescribed above. Where major cost items are Subcontracts, they shall be itemized also. In no case will a change be approved without such itemization.

7.5.4 Change orders, as they are accepted by the Owner, shall be entered under heading "Change Orders" in the next current Request for Payment.

7.5.5 All credits to or deductions from the Contract Sum, a Contingency or an Allowance shall be calculated using the same methodology set forth in this Section 7.5. All unused Contingency or Allowance amounts shall be credited back to Owner prior to final payment, along with any markups included in the Contract Sum or GMP on such unused amounts.

ARTICLE 8 -- TIME

8.1 DEFINITIONS

At Section **8.1.4**, add the following sentence:

See further definition of "Day" in Section **1.9.10**.

8.3 DELAYS AND EXTENSIONS OF TIME

Delete Section **8.3.1** in its entirety and substitute the following:

8.3.1 If the Contractor is delayed at any time in the commencement or progress of the Work by an act or neglect of the Owner or Architect, or of an employee of either, or of a separate contractor employed by the Owner, or by changes ordered in the Work, or by labor disputes, fire, unusual delay in deliveries, unavoidable casualties or other unforeseeable causes beyond the Contractor's control, or by other causes which the Architect determines may justify delay, then the Contract Time shall be extended by Change Order for such reasonable time as the Architect may determine. **No extensions of the Contract Time will be granted for inclement weather, except for Force Majeure weather events consisting of named storms or government declared emergencies resulting from extreme weather.**

Add Sections **8.3.4** and **8.3.5** as follows:

8.3.4 The parties hereto agree that time is of the essence of this Contract and that pecuniary damages would be suffered by the Owner if the Contractor does not substantially complete all Work called for in the Contract Document by the specified date, which damages are, by their very nature, difficult of ascertainment. It is therefore expressly agreed, as a part of the consideration inducing the Owner to execute this Contract that the Owner may deduct from the final payment made to the Contractor a sum equal to the amount stated stated in the Contract Documents, per phase for each and every Calendar Day beyond the agreed date which the contractor has agreed to for Substantial Completion of the Work included in the Contract Documents. 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 substantially completed within the agreed time, or with 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 or forfeiture; said damage being caused by additional compensation to personnel, and other miscellaneous increased costs, all of which are difficult of exact ascertainment. The liquidated damages assessed herein shall be Owner's sole remedy for time delays between the deadline for substantial completion and Contractor's achievement of substantial completion.

8.3.5 Failure to complete and close-out the Project, and complete all Punch List items, within sixty (60) days after the scheduled Substantial completion date will additionally entitle the Owner to deduct from the final payment made to the Contractor a sum equal to the amount stated in the Contract Documents, per phase, for each and every Calendar Day beyond the 60-day close-out period. It is expressly understood that said sum per day is agreed upon as a fair estimate of the pecuniary damages which will be sustained by the Owner in the event that the Project close-out does not occur on a timely basis. Said sum shall be considered as liquidated damages only and in no sense shall be considered a penalty or forfeiture; said damage being caused by additional compensation to personnel, and other miscellaneous increased costs, all of which are difficult of exact ascertainment. If the Contractor is delayed through no fault of the Owner, the Substantial Completion is not achieved by the agreed contract completion date, the Project close-out period of sixty (60) days will not be extended by the number of days of delay past the actual Substantial completion date and will remain based upon the agreed contract completion date.

ARTICLE 9 -- PAYMENTS AND COMPLETION

9.1 CONTRACT SUM

Add Section **9.1.1.1** as follows:

9.1.1.1 The Owner is exempt from payment of Texas State Sales Tax on materials required for the Work. Therefore, to comply with the law, the Contract Sum shall be broken down into the amount of cost for labor and the amount of cost for materials. This breakdown shall be provided by the Contractor within ten (10) days of award of Contract.

9.2 SCHEDULE OF VALUES

Add the following Sections:

9.2.1 General Contractor's cost for Contractor's fee, bonds and insurance, General Conditions, etc., shall be listed as individual line items.

9.2.2 Schedule of Values shall break each line into materials and labor. Once approved by the Owner and Architect, it shall be used as basis for reviewing Application for Payment but not be taken as evidence of market or other value.

9.2.3 Contractor's cost for various construction items shall be detailed. For example, concrete work shall be subdivided into footings, grade beams, floor slabs, paving, etc. These subdivisions shall appear as individual line items**.**

9.2.4 On major subcontracts, such as mechanical, electrical, and plumbing, the Schedule shall indicated line items and amounts in detail, (for example; underground, major equipment, fixtures, installation of fixtures, start up, etc.)

9.2.5 Costs for subcontract work shall be listed without any addition of General Contractor's costs for overhead, profit or supervision.

9.2.6 The Contractor shall include a value for the coordination documents/drawings on the schedule of values.

9.2.7 The Contractor shall include a value for the correction of deficiencies noted by the Commissioning Agent and the Test, Adjust and Balance consultant on the schedule of values for each sub-contractor subject to commissioning and test, adjust and balance requirements.

9.3 APPLICATIONS FOR PAYMENT

Delete Sections **9.3.1** and **9.3.2** in their entirety and replace them with the following:

9.3.1 Refer to Section 7.1.3 of the A133 Agreement for timelines related to Applications for Payment.

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

9.3.2 Payments will be made on account of materials or equipment 1) incorporated in the Work; 2) suitably stored at the site; or 3) suitably stored at some off-site location, provided the following conditions are met for off-site storage:

.1 The location must be agreed to, in writing, by the Owner and Surety.

.2 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 offsite storage area for confirmation.

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 stored off the site. Under no circumstances will the Owner reimburse the Contractor for down payments, deposits, or other advance payments for materials or equipment, without prior written approval of Owner.

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

Add Section **9.3.4** as follows:

9.3.4 The Contractor shall submit requests for payment in duplicate, using AIA Document G702, Application and Certificate of Payment, as the cover sheet. Continuation sheets showing in detail the amounts requested, etc., shall be submitted using AIA Document G703, Continuation Sheet, or a computerized version of these documents previously approved for use. The information provided on the continuation sheets in the Description of the Work and Scheduled Values columns shall match the corresponding information shown on the approved Schedule of Values. All blank spaces on AIA Document G702, Application and Certificate of Payment, must be completed and the signatures of the Contractor and Notary Public shall be original on each form. By submitting his application for payment, the Contractor certifies that the individual signing the application is authorized to do so.

9.6 PROGRESS PAYMENTS

Delete Section **9.6.1** in its entirety and substitute the following:

9.6.1 After the Architect has issued a Certificate for Payment, the Owner shall make progress payments in accordance with the following Section and Section 7.1.3 of the A133.

.1 Based upon the applications for payment and supporting documents submitted to the Architect by the Contractor and certification of the amount payable by the Architect, the Owner shall make progress payments on account of the Contract Sum to the Contractor as provided in the Contract Documents for the period covered by the application for payment:

.2 Applications for Payment shall be submitted by the last day of the month. Not later than the last day of the following month, ninety-five percent (95%) of the portion of the Contract Sum properly allocable to labor, materials, and equipment incorporated in the Work and ninety-five percent (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 (subject to the conditions listed in Article 9.3.2 of the Supplementary Conditions to the Contract for Construction), for the period covered by the Application for Payment, less the aggregate of previous payments made by the Owner.

.3 Upon Substantial Completion of the entire Work, a sum sufficient to increase the total payments to ninety-five percent (95%) of the Contract Sum, less such amounts as the Architect shall determine for all incomplete Work and unsettled claims as provided in the Contract Documents.

At Section **9.6.2**, insert the following sentence between the first and second sentence:

More specifically, if only five percent (5%) retainage is withheld by the Owner on payments to the Contractor, then the Contractor shall withhold only five percent (5%) retainage on payments to subcontractors; and subcontractors shall withhold only five percent (5%) retainage on payments to sub-subcontractors.

9.7 FAILURE OF PAYMENT

Delete the phrase "or awarded by binding dispute resolution." Replace all references to "seven days" to "ten days."

9.8 SUBSTANTIAL COMPLETION

At Section **9.8.2**, add the following sentence at the end:

Should the Architect determine that the Contractor's List of Items to be Completed or Corrected lacks sufficient detail or requires extensive supplementation, the list will be returned to the Contractor for revision, and inspection for determining the Date of Substantial Completion will be delayed until the List submitted is a reasonable representation of the work to be done.

Add Sections **9.8.6** and **9.8.7** as follows:

9.8.6 In order for the project or a major portion thereof to be considered substantially complete, the following conditions must be met:

.1 All inspections by governmental authorities having jurisdiction over the project must have been finalized, any remedial work required by those authorities must have been completed, and Certificates of Occupancy and similar governmental approval forms must have been issued and copies delivered to the Owner and Architect.

.2 All work, both interior and exterior, shall have been completed and cleaned except minor items which if completed after occupancy, will not, in the Owner's opinion, cause interference to the Owner's use of the building or any portion thereof. A significantly large number of items to be completed or corrected will preclude the Architect from issuing a Certificate of Substantial Completion. The Owner and Architect will be the sole judge of what constitutes a significantly large number of items.

The following items are a partial specific list of requirements, as applicable to the Project, that must be completed prior to established Substantial Completion of all portions of the work (Including the Substantial Completion of the commissioning phase).

1. All fire alarm system components must be completed and demonstrated to the Owner.

2. Local fire marshal approval certificate, or similar Certificate of Occupancy from the governing agency, must be delivered to the Owner.
3. All exterior clean-up and landscaping must be complete.
4. All final interior clean-up must be complete.
5. All HVAC air and water balancing must be complete.
6. All required commissioning must be complete.
7. All Energy Management Systems must be complete and fully operational and demonstrated to the Owner.
8. All communications equipment, telephone system, and P.A. systems must be complete and demonstrated to the Owner.
9. All final lockset cores must be installed and all final Owner directed keying completed.
10. All room plaques and exterior signage must be completed.
11. All Owner demonstrations must be completed including kitchen equipment, HVAC equipment, plumbing equipment, and electrical equipment.
12. A final certificate of occupancy must be signed by the Contractor and delivered to the Owner.

9.8.7 After the date of Substantial Completion of the Project is evidenced by the Certificate of Substantial Completion, the Contractor will be allowed a period of time within which to correct all deficiencies attached to the Certificate of Substantial Completion as outlined in Section 8.3.4 of these supplementary conditions. Failure of the Contractor to complete such corrections within the stipulated time will be reported to the contractor's surety. In this report, the Contractor and surety will be informed that, should correction remain incomplete for fifteen (15) days, the Owner may initiate action to complete corrective work out of the remaining Contract funds in accordance with Article 14.2.

.1 Should corrective work following Substantial Completion require more than one reinspection after notification by the Contractor that corrections are complete, the cost of subsequent inspections may also be deducted from the Contract funds remaining unpaid to the Contractor.

9.10 FINAL COMPLETION AND FINAL PAYMENT

At Section **9.10.2**, add the following sentence **at the end**:

Prior to final payment, the Contractor shall meet all of the requirements of Owner's Closeout Procedures.

Add Section **9.10.6** as follows:
9.10.6 Final Payment, constituting the entire unpaid balance of the Contract Sum, shall be paid by the Owner to the Contractor thirty-one (31) days after Substantial Completion of the Work unless otherwise stipulated in the Certificate of Substantial Completion, provided the Work has then been completed, the Contract fully performed, all Contract Close Out Documents have been submitted, and the Final Certificate for Payment has been issued by the Architect. The final payment will not be made until all of these conditions have been satisfied.

ARTICLE 10 -- PROTECTION OF PERSONS AND PROPERTY

Add Sections **10.2.9** and **10.2.10** as follows:

10.2.9 The performance of the foregoing services by the Contractor shall not relieve the Subcontractors of their responsibilities for the safety of persons and property and for compliance with all applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities applicable to the conduct of the Work.

10.2.10 The Contractor shall be responsible for taking all precautions necessary to protect the Work in place from any foreseeable weather conditions which could cause any potential damage to portions or all Work in place. The Contractor shall be responsible for performing all repairs and/or replacement of any Work that results from foreseeable weather conditions.

10.3 HAZARDOUS MATERIALS

Delete the text of Section **10.3.1** in its entirety and substitute the following:

10.3.1 The Contractor is responsible for compliance with any requirements included in the Contract Documents regarding hazardous materials. If the Contractor encounters a hazardous material or substance not addressed in the Contract Documents and if reasonable precautions will be inadequate to prevent foreseeable bodily injury or death to persons resulting from a material or substance encountered on the site by the Contractor, the Contractor shall, upon recognizing the condition, immediately stop Work in the affected area and report the condition to the Owner and Architect in writing. The Owner, Contractor and Architect shall then proceed in the same manner described in Section 10.3.2.

Delete the text of Sections **10.3.3, 10.3.4** and **10.3.5** in their entirety.

Delete the text of Section **10.3.6** in its entirely and substitute the following:

10.3.6 If, without negligence on the part of the Contractor, the Contractor is held liable by a governmental agency for the cost of remediation of a hazardous material or substance solely by reason of performing Work as required by the Contract Documents, the Owner shall indemnify the Contractor for all costs and expenses thereby incurred, but only to the extent provided by law.

Add Section **10.3.7** as follows:

10.3.7 As part of the construction contract close out process, and prior to receiving payment of any of the retainage, the Contractor and his subcontractors shall submit notarized statements pertaining to the above referenced hazardous materials.

ARTICLE 11 -- INSURANCE AND BONDS

Delete the text of Sections 11.1 through 11.5 and substitute the following Sections:

11.1 CONTRACTOR'S LIABILITY INSURANCE

The Owner reserves the right to review the insurance requirements during the effective period of any Contract to make reasonable adjustments to insurance coverages and limits when deemed reasonably prudent by Owner based upon changes in statutory laws, court decisions or potential increase in expense to loss.

11.2 The Owner requires the following minimum insurance coverages:

Types of Coverage	Limits of Liability	
Commercial General Liability	General Aggregate	$2,000,000.00
	Products/Completed Operations/Aggregate	$1,000,000.00
	Bodily Injury and Property Damage (each)	$1,000,000.00
	Contractual	$1,000,000.00
	Personal and Advertising Injury	$1,000,000.00

	Fire Damage	$500,000.00
	Medical Expense	$5,000.00

11.2.1 The Owner shall be named as an additional insured on a primary and non-contributory basis using form CG 2010 10 01 or similar endorsement providing equal or greater coverage in favor of the Owner.

Coverage shall include the following:
(a) Premises operations;
(b) Blanket Contractual Liability;
(c) Pollution;
(d) Products/Completed Operations;
(e) Broad Form Property Damage;
(f) Independent Contractors;
(g) Per project aggregate limit;
(h) Provide a statement of claims against the aggregate limit with each renewal certificate;
(i) X,C,U exclusions to be removed when underground work is performed; and
(j) Waivers of subrogation in favor of Owner and its officers, directors, representatives, agents and employees shall be provided.

11.2.2 Automobile Liability — Combined Single Limit — $1,000,000.00

(a) Comprehensive Automobile Liability Insurance to cover all vehicles owned by, hired by, or used on behalf of Contractor.

(b) Owner and its officers, directors, representatives, agents and employees shall be endorsed as Additional Insureds, as their interests may appear.

(c) Waivers of subrogation in favor of Owner and its officers, directors, representatives, agents and employees shall be provided.

11.2.3 Workers' Compensation — Statutory Limits

(a) Coverage at Statutory Limits with All States Endorsement

(b) Employer's Liability	Each Accident	$1,000,000.00
	Disease (Policy Limit)	$1,000,000.00
	Disease (Each Employee)	$1,000,000.00

(c) Waivers of subrogation in favor of Owner and its officers, directors, representatives, agents and employees shall be provided.

11.2.4 Excess or Umbrella Insurance (provides coverage in excess of primary Commercial General Liability, Automobile Liability, and Worker's Compensation Coverage B limits)

(a) Minimum coverage for the Contractor shall be one (1) times the Contract amount, subject to a minimum limit of $1,000,000.00 and a maximum limit of $25,000,000.00. Limits for primary policies may differ from those shown above when Excess (Umbrella) Insurance coverage is provided.

(b) Owner and its officers, directors, representatives, agents and employees shall be endorsed as Additional Insureds, as their interests may appear.

(c) Waivers of subrogation in favor of Owner and its officers, directors, representatives, agents and employees shall be provided.

11.3 The Owner requires that the following insurance requirements be satisfied:

.**1** No Work shall be commenced until all insurance requirements set forth in this Agreement have been approved by the Owner in writing.

.**2** All insurance policies and certificates required hereunder shall be in form and content satisfactory to the Owner.

.**3** The Owner shall be furnished an ACORD form Certificate of Insurance evidencing all policies and endorsements required by this Agreement prior to execution of the Contract and thereafter upon renewal or replacement of each required policy of insurance.

.4 Each Insurance coverage/policy shall contain a provision that at least thirty (30) days prior written notice shall be given to the Owner in the event of cancellation, material change, or non-renewal.

.5 Insurance shall be underwritten by a company licensed to do business in Texas, satisfactory to Owner and rated minimum A-VII by A.M. Best.

.6 The insurance coverages specified herein shall be maintained at all times during the term of the contract and, with the exception of builder's risk coverage, shall be maintained for a minimum of one (1) year thereafter.

.7 No deletions/exclusions from the standard coverage form are allowed without the prior written consent of the Owner.

.8 All insurance must be issued on an occurrence basis.

.9 The Contractor shall be responsible for all deductibles; the Owner shall approve the deductibles selected.

.10 With the exception of Excess Umbrella Coverage, the coverage afforded by each carrier must be a primary over any other applicable insurance.

.11 In addition to certificates of insurance, copies of policy endorsements must be provided (a) listing the Owner as Additional Insured, and (b) showing waivers of subrogation in favor of the Owner.

11.4 PERFORMANCE BOND AND PAYMENT BOND

Add the following Sections:

11.4.1 The Contractor shall provide a Performance Bond, in the penal sum equal to one hundred percent (100%) of the Contract Sum, if the formal Contract is in excess of One Hundred Thousand Dollars ($100,000.00) and a Labor and Material Payment bond, in the penal sum equal to one hundred percent (100%) of the Contract sum if the formal contract is in excess of Twenty Five Thousand Dollars ($25,000.00).

11.4.2 The Work will not be started until the bonds and issuing companies have been accepted as satisfactory by the Owner. The original bonds will be delivered to the Owner with an attached authorized power of attorney. Such Bonds shall be issued by a company authorized to do business in the State of Texas with an A.M. Best Company rating of a least A-X and included on the U.S. Department of the Treasury Listing of Approved Sureties (Dept. Circular 570).

11.4.3 The Performance Bond Form and the Payment Bond Form included herein shall be executed and submitted to the Architect in duplicate prior to commencement of the work. The surety companies must be acceptable to the Owner and licensed admitted carriers in the State of Texas; and the companies must appear in a current Federal Treasury list as Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds land as Acceptable Reinsuring companies.

11.4.4 Each bond shall be of penal sum equal to one hundred percent (100%) of the Contract Sum and shall be compatible with the provisions of the governing authority. The Contractor shall file copies of each bond with the county clerk and furnish the Owner with a file receipt. The bonds shall remain in force throughout the warranty period of the contract. The Work will not be started until the bonds and issuing companies have been accepted as satisfactory by the Owner. The original bonds will be delivered to the Owner with an authorized power of attorney attached.

11.4.5 Claims must be sent to the Contractor and his Surety in accordance with Article 5160, Revised Civil Statutes. The Owner will furnish in accordance with such Article, a copy of the Payment Bond as provided therein to claimants upon request. All claimants are cautioned that no lien exists on the funds unpaid to the contractor on such Contract, and that reliance on notices sent to the Owner may result in loss of their rights against the Contractor and/or his Surety. The Owner is not responsible in any manner to a claimant for collection of unpaid bills, and accepts no responsibility because of any representation by any agent or employee.

11.5 WORKER'S COMPENSATION INSURANCE COVERAGE

11.5.1 Comply with the requirements of Rule 28, TAC §110.110, Reporting Requirements for Building or Construction Projects for Governmental Entities

11.5.2 DEFINITIONS:

.1 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 service as on a project, for the duration of the project.

.2 Duration of the project –includes the time from the beginning of the work on the project until the contractor's/person's work on the project has been completed and accepted by the governmental entity.

.3 Persons providing services on the project ("subcontractor" in §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 which furnishes persons to provide services on the project. "Services" 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 delivery, and delivery of portable toilets.

11.5.3 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, Section 401.011(44) for all employees of the Contractor providing services on the project, for the duration of the project.

11.5.4 The Contractor must provide a certificate of coverage to the governmental entity prior to being awarded the contract.

11.5.5 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 that coverage has been extended.

11.5.6 The Contractor shall obtain from each person providing services on a project, and provide to the governmental entity:

.1 A certificate of coverage, prior to that person beginning work on the projects so the governmental entity will have on file certificates of coverage showing coverage for all persons providing services on the project, and

.2 No later than seven 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.

11.5.7 The Contractor shall retain all required certificates of coverage for the duration of the project and for one year thereafter.

11.5.8 The Contractor shall notify the governmental entity in writing by certified mail or personal delivery, within 10 days after the Contractor knew or should have known, of any change that materially affects the provision of coverage of any person providing services on the project.

11.5.9 The Contractor shall post on each project site a notice, in the text, form and manner prescribed by the Texas Worker's Compensation, 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 coverage.

11.5.10 The Contractor shall contractually require each person with whom it contracts to provide services on a project, to:

.1 Provide coverage, based on proper reporting of classification codes and payroll amounts and filing of any coverage agreements, which meet 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.

.**2** Provide 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.

.3 Provide the Contractor, prior to the end of the coverage period shown on the current certificate ends during the duration of the project.

.**4** Obtain from each other person with whom it contracts, and provides 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.

.5 Retain all required certificates of coverage on file for the duration of the project and for one year thereafter.

.**6** 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 provision of coverage of any person providing services on the project, and

.7 Contractually require each person with whom it contracts, to perform as required by these subsections (1)-(7), with the certificates of coverage to be provided to the person for whom they are providing services.

11.5.11 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 a 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 actions.

11.5.12 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.

ARTICLE 12—UNCOVERING AND CORRECTION OF WORK

12.2.1 BEFORE SUBSTANTIAL COMPLETION

After Section **12.2.1** add the following Sections:

12.2.1.**1** In the event of failure of a specified project, either during construction or the correction period, the Contractor shall take appropriate measures with the manufacturer of the product to assure correction or replacement of the defective products.

12.2.1.**2** Refer to 01 77 00, Closeout Procedures in Division One for further terms regarding warranties which will be required prior to final payment.

12.2.2 AFTER SUBSTANTIAL COMPLETION

After Section **12.2.2** add the following Section:

12.2.2.**1** Approximately eleven months after substantial completion, the contractor shall accompany the Owner and Architect on an "end of the one year correction period" reinspection of the Project. Additional deficiencies observed or reported shall be corrected by the Contractor.

12.3 ACCEPTANCE OF NONCONFORMING WORK

Number the existing provision as Section **12.3.1**, and add Section **12.3.2** as follows:

12.3.2 The Owner's use and/or occupancy of any or all of the Project site shall never be construed as an acceptance of Work not in conformance with Contract Documents. The Owner reserves the right to enforce provisions of the Contract unless the Owner's acceptance is provided to the Contractor in writing.

ARTICLE 13—MISCELLANEOUS PROVISIONS

Add Sections **13.7**, **13.8, 13.9, 13.10, and 13.11** as follows:

13.7 EQUAL OPPORTUNITY

13.7.1 The contractor shall maintain policies of employment as follows:

.1 The Contractor and the Contractor's Subcontractors shall not discriminate against any employee or applicant for employment because of race, religion, color, sex or national origin. The Contractor shall take affirmative action to insure that applicants are employed, and that employees are treated during employment without regard to their race, religion, color, sex or national origin. Such action shall include, but not be limited to, the following: employment, upgrading, demotion transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The Contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices setting forth the policies of non-discrimination.

13.8 CRIMINAL BACKGROUND CHECKS

The Contractor/Subcontractor shall certify that employees who (i) have or will have continuing duties related to the contracted services, and (ii) have or will have direct contact with students (substantial opportunity for verbal or physical interaction with students that is not supervised by a certified educator or other professional District employee)have submitted all information necessary for the LEE Fast Pass process, but such firm does not have access to the results of the criminal history search, as stated in the form included herein.

13.9 REQUIRED CERTIFICATIONS

Contractor hereby certifies that it is not a company identified on the Texas Comptroller's list of companies known to have contracts with, or provide supplies or services to, a foreign organization designated as a Foreign Terrorist Organization by the U.S. Secretary of State under federal law. Contractor hereby certifies and verifies that neither Contractor, nor any affiliate, subsidiary, or parent company of Contractor, if any (the "Contractor Companies"), boycotts Israel, and contractor agrees that Contractor and Contractor Companies will not boycott Israel during the term of this Agreement. For purposes of this Agreement, the term "boycott" shall mean and include terminating business activities or otherwise taking any action that is intended to penalize, inflict economic harm on, or limit commercial relations with Israel, or with a person or entity doing business in Israel or in an Israeli-controlled territory.

13.11 PROHIBITION ON CONTRACTS WITH COMPANIES THAT BOYCOTT ENERGY COMPANIES

By entering into this Agreement, Contractor represents and warrants that: (1) it does not, and will not for the duration of the contract, boycott energy companies or (2) the verification required by Section 2274.002 of the Texas Government Code does not apply to the contract.

13.12 PROHIBITION ON COMPANIES THAT DISCRIMINATE AGAINST FIREARM INDUSTRY

By entering into this Agreement, Contractor verifies that: (1) it does not, and will not for the duration of the contract, have a practice, policy, guidance, or directive that discriminates against a firearm entity or firearm trade association or (2) the verification required by Section 2274.002 of the Texas Government Code does not apply to the contract.

ARTICLE 14—TERMINATION OR SUSPENSION OF THE CONTRACT

Delete the text of Section 14.1.3 in its entirety and substitute the following:

14.1.3 If one of the reasons described in Section 14.4.1 or 14.4.2 exists, the Contractor may, upon seven day's written notice to the Ower and Architect, terminate the Contract and recover from the Owner payment for Work executed as of the date of the notice, plus costs of demobilization.

14.4 TERMINATION BY THE OWNER FOR CONVENIENCE

Delete the text of Section **14.4.3** in its entirety and substitute the following:

14.4.3 In the case of such termination for the Owner's convenience, the Contractor shall be entitled to receive payment for Work executed up to date of receipt of the notice of termination, plus costs of demobilization.

ARTICLE 15—CLAIMS AND DISPUTES

15.1 CLAIMS

Delete the text of Section **15.1.1** in its entirety and substitute the following:

15.1.1 DEFINITION

A Claim is a demand or assertion by one of the parties seeking, as a matter of right, adjustment or interpretation of contract terms, payment of money, extension of time or other relief with respect to the terms of the Contract. The term "Claim" also includes other disputes and matters in question between the Owner, Architect, and Contractor arising out of or relating to the Contract. The responsibility to substantiate Claims shall rest with the party making the Claim. Nothing herein shall require the Owner to make or file a Claim in order to assess liquidated damages provided for in the Contract Documents.

15.1.2 TIME LIMITS ON CLAIMS

Delete the last sentence of Section **15.1.2** in its entirety.

15.1.3 NOTICE OF CLAIMS

Delete the second sentence of Section **15.1.3** in its entirety and substitute the following:

Claims by either party must be initiated within ninety (90) days after occurrence of the event giving rise to such Claim or within ninety (90) days after the claimant first recognizes the condition giving rise to the Claim, whichever is later.

15.1.6 CLAIMS FOR ADDITIONAL TIME

Delete the text of **Section 15.1.6.2** in its entirety and substitute the following:

15.1.6.2<u>No extenstions of the Contract Time will be granted for inclement weather, except as provided in Section 8.3.1.</u>

15.1.7 CLAIMS FOR CONSEQUENTIAL DAMAGES

Delete the text of Section **15.1.7** in its entirety.

15.2 INITIAL DECISION

Delete the text of Section **15.2.1** in its entirety and substitute the following:

15.2.1 Claims, excluding those alleging an error or omission by the Architect or those arising after expiration of the period for correction of the Work, shall be referred to the Initial Decision Maker for initial decision. The Architect will serve as the Initial Decision Maker, unless otherwise indicated in the Agreement. If the parties are unable to agree, any claim, dispute or matters arising out of the contract between the Architect, Owner and Contractor or any combination of those parties shall be submitted to a court of appropriate jurisdiction.

Delete the text of Section **15.2.5** in its entirety and substitute the following:

15.2.5 The Initial Decision Maker will render an initial decision approving or rejecting the Claim, or indicating that the initial Decision Maker is unable to resolve the Claim. This initial decision shall (1) be in writing; (2) state the reasons therefore; and (3) notify the parties and the Architect, if the Architect is not serving as the Initial Decision Maker, of any change in the Contract Sum or Contract Time or both. The initial decision shall be final and binding on the parties, but subject to mediation, if both parties so agree, and subject to legal or equitable proceedings in a court having jurisdiction thereof. It is understood and agreed that, in the event that any dispute, controversy, or conflict arises during the design and construction of the Project or following its completion, the parties hereto will cooperate in good faith, if possible, to resolve the issues without resorting to litigation.

Delete the text of Sections **15.2.6** and **15.2.6.1** in their entirety.

Add the following Section **15.2.9**

15.2.9 The prevailing party in any judicial proceeding arising from the Contract Documents shall recover its reasonable and necessary attorneys' fees.

15.3 MEDIATION

15.3.1 Delete the text of **15.3.1** in its entirety.

Delete Section **15.3.2** in its entirety and replace with the following:

15.3.2 The parties may mutually agree to resolve their claims by mediation which, unless the parties mutually agree otherwise, shall be in accordance with the Construction Industry Mediation Rules of the American Arbitration Association currently in effect. Request for mediation shall be filed in writing with the other party to the Contract. Mediation shall proceed in advance of legal or equitable proceedings, which shall be stayed pending mediation for a period of 60 days from the date of filing unless stayed for a longer period of agreement of the parties or court order.

15.4 ARBITRATION

Delete the text of Sections **15.4.1** through **15.4.3** and **15.4.4.1** through **15.4.4.3** in their entirety.

END OF DOCUMENT 007300A

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SECTION 011000 - SUMMARY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Project information.
2. Work covered by Contract Documents.
3. Phased construction.
4. Work under Owner's separate contracts.
5. Owner-furnished/Contractor-installed (OFCI) products.
6. Watertight – weathertight requirements.
7. Contractor's use of site and premises.
8. Coordination with occupants.
9. Work restrictions.
10. Specification and Drawing conventions.

B. Related Requirements:

1. Section 015000 "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.
2. Section 017300 "Execution" for coordination of Owner-installed products.

1.3 PROJECT INFORMATION

A. Project Identification: Klein Independent School District, Schindewolf Gym Addition, DLR Group Project No. 39-25107-00.

1. Project Location: 20903 Ella Blvd, Spring, Texas 77388.

B. Owner: Klein Independent School District, 7200 Spring Cypress Road, Klein, Texas 77379, Phone (832) 249-4000.

1. Owner's Representative: Danny Phillips, RTSBO, AIC, CPC, Executive Director Department of Capital Projects.
   7520 FM 2920
   Klein, Texas 77379
   Email: dphillips3@kleinisd.net

Phone: (832) 249-4240

C. Architect:

1. DLR Group inc. of Texas, a Texas corporation
1000 Louisiana Street, Suite 1100
Houston, Texas 77002
Phone: (713) 561-3925

a. Client Leader: A.J Sustaita, AIA
Email: asustaita@dlrgroup.com
Mobile Phone: (713) 385-0312

b. Project Manager: Paul Kenney, RA
Email: pkenney@dlrgroup.com
Mobile Phone: (409) 201-9843

D. Architect's Consultants: Architect has retained the following design professionals, who have prepared designated portions of the Contract Documents:

1. Civil Engineering: Kimley-Horn and Associates, Inc..

a. Representative: Rashard Harris, P.E.
Email: rashard.harris@kimley-horn.com
11700 Katy Freeway, Suite 800
Houston, Texas 77079
Phone: (281) 597-9300

2. Structural Engineering: Matrix Structural Engineers

a. Representative: Jay Khayrattee, P.E., LEED BD+C
Email: jayk@matrixstructural.com
5177 Richmond Avenue
Suite 670
Houston, Texas 77056
Phone: (713) 664-0130

3. Mechanical, Plumbing and Electrical Engineering: DBR Engineering Consultants, Inc.

a. Representative: Brent Moe, P.E.
Email: bmoe@dbrinc.com
9990 Richmond Avenue
South Building Suite 3000
Houston, Texas 77042
Phone: (713) 914-0888

4. Technology Consulting Services: True North Consulting Group

    a. Representative: Jose Cadavid, PMP. CDCDP, CNIDP
    Email: jose.cadavid@tncg.com
    2000 W Loop S, Suite 1340
    Houston, Texas 77027
    Phone: (888) 650-4580

E. Web-Based Project Software: Project software will be used for purposes of managing communication and documents during the construction stage.

1. See Section 013100 "Project Management and Coordination." for requirements for using web-based Project software.

1.4 WORK COVERED BY CONTRACT DOCUMENTS

A. The Work of Project is defined by the Contract Documents and includes, but is not limited to, the following:

1. Two story addition to the existing intermediate school consisting of gymnasium, toilet rooms, and support/mechanical/electrical spaces that has a gross area of 13,000 square feet. Selected renovation work within the existing building and other Work indicated in the Contract Documents.

B. Type of Contract:

1. Project will be constructed under a single prime contract.

C. Construction Schedule Milestone Dates:

1. Substantial Completion: The Project shall be substantially complete on or before March 25, 2026.
2. Final Completion: Upon reaching Substantial Completion, the outstanding items shall be completed and/or corrected no later than April 22, 2026.

D. Liquidated Damages: The Contractor and the Contractor’s surety, if any, shall be liable for and pay the Owner liquidated damages for each calendar day that the Work remains incomplete after the date established for Substantial Completion and Final Completion, as described in the General and Supplemental Conditions of the Contract for Construction, Paragraph 9.11.

1.5 PHASED CONSTRUCTION

A. Coordinate Work schedule within the existing building with the Owner and the Architect to minimize the disruption of school activities.

1.6 WORK UNDER OWNER'S SEPARATE CONTRACTS

A. Work with Separate Contractors: Cooperate fully with Owner's separate contractors, so work on those contracts may be carried out smoothly, without interfering with or delaying Work under this Contract or other contracts. Coordinate the Work of this Contract with work performed under Owner's separate contracts.

B. Concurrent Work: Owner will award separate contract(s) for the following construction operations at Project site. Those operations will be conducted simultaneously with Work under this Contract.

1. Test and Balance Commissioning Consultants: To firm to be determined and paid directly by Owner for testing, adjusting, and balancing air conditioning systems and commissioning work.

1.7 OWNER-FURNISHED/CONTRACTOR-INSTALLED (OFCI) PRODUCTS

A. Owner's Responsibilities: Owner will furnish products indicated and perform the following, as applicable:

1. Provide to Contractor Owner reviewed Product Data, Shop Drawings, and Samples.
2. Provide for delivery of Owner-furnished products to Project site.
3. Upon delivery, inspect, with Contractor present, delivered items.

    a. If Owner-furnished products are damaged, defective, or missing in shipping, arrange for replacement.

4. Obtain manufacturer's inspections, service, and warranties.
5. Inform Contractor of earliest available delivery date for Owner-furnished products.

B. Contractor's Responsibilities: The Work includes the following, as applicable:

1. Provide a quantity take-off of the Owner furnished products and provide quantities to the Owner in a reasonable time to allow adequate ordering.
2. Designate delivery dates of Owner-furnished products in Contractor's construction schedule, utilizing Owner-furnished earliest available delivery dates.
3. Review Owner-reviewed Product Data, Shop Drawings, and Samples, noting discrepancies and other issues in providing for Owner-furnished products in the Work.
4. Receive, unload, handle, store, protect, and install Owner-furnished products.
5. Make building services connections for Owner-furnished products.
6. Protect Owner-furnished products from damage during storage, handling, and installation and prior to Substantial Completion.
7. Repair or replace Owner-furnished products damaged following receipt if cause by Contractor.

C. Owner-Furnished/Contractor-Installed (OFCI) Products:

1. Toilet Accessories as indicated on the Drawings, Enlarged Plans, and a s specified in Section 102800 “Toilet, Bath, and Laundry Accessories.”

1.8 WATERTIGHT – WEATHERTIGHT REQUIREMENTS

A. Anything in the Contract Documents notwithstanding, the Contractor accepts the responsibility of constructing a watertight, weathertight Project.

B. Discovery of Fungi (Mold): The Contractor is responsible for providing labor, material, products, equipment, and services to install insulation, air/vapor barrier, and ventilation systems that maintain effective control of air, moisture, and heat transfer within the building envelope.

1. Should Contractor proceed to install insulation, ceiling tiles, gypsum wallboard or similar products having paper, cardboard and other cellulose surfaces prior to the building's being enclosed and weatherproof (including ambient conditions of temperature and humidity being continuously maintained at values near those indicated for final occupancy), the Contractor is at risk for mold contamination of the building components.
2. During the course of construction of the Project, Contractor shall perform continuous visual inspection/verification of building components and ventilation systems (particularly for damp filters) for possible contamination by mold.

1.9 CONTRACTOR'S USE OF SITE AND PREMISES

A. Restricted Use of Site: Contractor shall have limited use of Project site for construction operations as indicated on Drawings by the Contract limits and as indicated by requirements of this Section.

B. Limits on Use of Site: Limit use of Project site to Work in areas indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.

1. Driveways, Walkways and Entrances: Keep driveways loading areas, and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or for storage of materials.

a. Schedule deliveries to minimize use of driveways and entrances by construction operations.
b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.

C. Condition of Existing Building: Maintain portions of existing building affected by construction operations in a weathertight condition throughout construction period. Repair damage caused by construction operations.

D. Condition of Existing Grounds: Maintain portions of existing grounds, landscaping, and hardscaping affected by construction operations throughout construction period. Repair damage caused by construction operations.

1.10 COORDINATION WITH OCCUPANTS

A. Full Owner Occupancy: Owner will occupy Project site and existing building(s) during entire construction period. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's day-to-day operations. Maintain existing exits unless otherwise indicated.

1. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from Owner and approval of authorities having jurisdiction.
2. Notify Owner not less than 72 hours in advance of activities that will affect Owner's operations.

B. Owner Limited Occupancy of Completed Areas of Construction: Owner reserves the right to occupy and to place and install equipment in completed portions of the Work, prior to Substantial Completion of the Work, provided such occupancy does not interfere with completion of the Work. Such placement of equipment and limited occupancy shall not constitute acceptance of the total Work.

1. Architect will prepare a Certificate of Substantial Completion for each specific portion of the Work to be occupied prior to Owner acceptance of the completed Work.
2. Obtain a Certificate of Occupancy from authorities having jurisdiction before limited Owner occupancy.
3. Before limited Owner occupancy, mechanical and electrical systems shall be fully operational, and required tests and inspections shall be successfully completed. On occupancy, Owner will operate and maintain mechanical and electrical systems serving occupied portions of Work.
4. On occupancy, Owner will assume responsibility for maintenance and custodial service for occupied portions of Work.

1.11 WORK RESTRICTIONS

A. Comply with restrictions on construction operations.

1. Comply with limitations on use of public streets, work on public streets, rights of way, and other requirements of authorities having jurisdiction.

B. On-Site Work Hours: Limit work to between 7:00 a.m. to5:00 p.m., Monday through Friday, unless otherwise indicated. Work hours may be modified to meet Project requirements if approved by Owner and authorities having jurisdiction.

1. Weekend Hours: As permitted by the Owner.
2. Early Morning Hours: As permitted by the Owner.
3. Work in Existing Building: As permitted by the Owner.
4. Hours for Utility Shutdowns: Non-occupied days/hours.
5. Hours for Core Drilling: Before or after school hours.

C. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging for temporary utility services according to requirements indicated:

1. Notify Architect and Owner not less than seven days in advance of proposed utility interruptions.
2. Obtain Owner's written permission before proceeding with utility interruptions.

D. Noise, Vibration, Dust, and Odors: Coordinate operations that may result in high levels of noise and vibration, dust, odors, or other disruption to Owner occupancy with Owner.

1. Notify Architect and Owner not less than three days in advance of proposed disruptive operations.
2. Obtain Owner's written permission before proceeding with disruptive operations.

E. Smoking and Controlled Substance Restrictions: Use of tobacco products , alcoholic beverages, and other controlled substances on Project site is not permitted.

F. Employee Identification: Provide identification tags for Contractor personnel working on Project site. Require personnel to use identification tags at all times.

G. Employee Screening: Comply with Owner's requirements for drug and background screening of Contractor personnel working on Project site.

1. Maintain list of approved screened personnel with Owner's representative.

1.12 SPECIFICATION AND DRAWING CONVENTIONS

A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:

1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
2. Text Color: Text used in the Specifications, including units of measure, manufacturer and product names, and other text may appear in multiple colors or underlined as part of a hyperlink; no emphasis is implied by text with these characteristics.
3. Hypertext: Text used in the Specifications may contain hyperlinks. Hyperlinks may allow for access to linked information that is not residing in the Specifications. Unless otherwise indicated, linked information is not part of the Contract Documents.
4. Specification requirements are to be performed by Contractor unless specifically stated otherwise.

B. Division 00 Contracting Requirements: General provisions of the Contract, including General and Supplementary Conditions, apply to all Sections of the Specifications.

C. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.

D. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:

1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
2. Abbreviations: Materials and products are identified by abbreviations scheduled on Drawings.
3. Reference Keynoting to Specifications: Materials and products are identified by reference keynotes referencing Specification Section numbers found in this Project Manual.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 011000

SECTION 012100 - ALLOWANCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements governing allowances.

B. Types of allowances include the following:

1. Owner’s contingency allowances.

C. Related Requirements:

1. Section 012600 "Contract Modification Procedures" for procedures for submitting and handling Change Orders.

1.3 DEFINITIONS

A. Allowance: A quantity of work or dollar amount included in the Contract, established in lieu of additional requirements, used to defer selection of actual materials and equipment to a later date when direction will be provided to Contractor. If necessary, additional requirements will be issued by Change Order.

1.4 SELECTION AND PURCHASE

A. At the earliest practical date after award of the Contract, advise Architect of the date when final selection, or purchase and delivery, of each product or system described by an allowance must be completed by the Owner to avoid delaying the Work.

B. At Architect's request, obtain proposals for each allowance for use in making final selections. Include recommendations that are relevant to performing the Work.

C. Purchase products and systems selected by Architect from the designated supplier.

1.5 ACTION SUBMITTALS

A. Submit proposals for purchase of products or systems included in allowances in the form specified for Change Orders.

1.6 INFORMATIONAL SUBMITTALS

A. Submit invoices or delivery slips to show actual quantities of materials delivered to the site for use in fulfillment of each allowance.

B. Submit time sheets and other documentation to show labor time and cost for installation of allowance items that include installation as part of the allowance.

C. Coordinate and process submittals for allowance items in same manner as for other portions of the Work.

1.7 OWNER’S CONTINGENCY ALLOWANCES

A. Use the Owner’s contingency allowance only as directed by Architect for Owner's purposes and only by Change Orders that indicate amounts to be charged to the allowance.

B. Contractor's overhead, profit, and related costs for products and equipment ordered by Owner under the contingency allowance are included in the allowance and are not part of the Contract Sum. These costs include delivery, installation, insurance, equipment rental, and similar costs.

C. Change Orders authorizing use of funds from the contingency allowance will include Contractor's related costs and reasonable overhead and profit.

D. At Project closeout, credit unused amounts remaining in the contingency allowance to Owner by Change Order.

1.8 ADJUSTMENT OF ALLOWANCES

A. Allowance Adjustment: To adjust allowance amounts, prepare a Change Order proposal based on the difference between purchase amount and the allowance, multiplied by final measurement of work-in-place where applicable. If applicable, include reasonable allowances for cutting losses, tolerances, mixing wastes, normal product imperfections, required maintenance materials, and similar margins.

1. Include installation costs in purchase amount only where indicated as part of the allowance.
2. If requested, prepare explanation and documentation to substantiate distribution of overhead costs and other markups.

B. Submit claims for increased costs due to a change in the scope or nature of the allowance described in the Contract Documents, whether for the purchase order amount or Contractor's handling, labor, installation, overhead, and profit.

1. No change to Contractor's indirect expense is permitted for selection of higher- or lower-priced materials or systems of the same scope and nature as originally indicated.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine products covered by an allowance promptly on delivery for damage or defects. Return damaged or defective products to manufacturer for replacement.

3.2 PREPARATION

A. Coordinate materials and their installation for each allowance with related materials and installations to ensure that each allowance item is completely integrated and interfaced with related work.

3.3 SCHEDULE OF ALLOWANCES

A. Allowance No. 1: Owner’s Contingency Allowance: Include a contingency allowance of $400,000.00 for use according to Owner's written instructions.

END OF SECTION 012100

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SECTION 012300 - ALTERNATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for alternates.

1.3 DEFINITIONS

A. Alternate: An amount proposed by bidders and stated on the Bid Form for certain work defined in the bidding requirements that may be added to or deducted from the base bid amount if the Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.

1. Alternates described in this Section are part of the Work only if enumerated in the Agreement.
2. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternates into the Work. No other adjustments are made to the Contract Sum.

1.4 PROCEDURES

A. Coordination: Revise or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.

1. Include, as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation, whether or not indicated as part of alternate.

B. Execute accepted alternates under the same conditions as other Work of the Contract.

C. Schedule: A Part 3 "Schedule of Alternates" Article is included at the end of this Section. Specification Sections referenced in schedule contain requirements for materials necessary to achieve the work described under each alternate.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF ALTERNATES

A. Alternate No. 1: Resilient Athletic Flooring (RF-01).

1. Base Bid: Taraflex Sport M Plus by Gerflor, ASTM F2772 Class 3 shock absorption as indicated on Drawings and as specified in Section 096566 "Resilient Athletic Flooring."
2. Alternate No. 1A: Deduct Base Bid product and add Taraflex Multi-Use 6.2 by Gerflor, ASTM F2772 Class 2 shock absorption as indicated on Drawings and as specified in Section 096566 "Resilient Athletic Flooring."
3. Alternate No. 1B: Resilient Athletic Flooring (RF-01). Deduct Base Bid product and add Tarkett comparable flooring product.

B. Alternate No. 2. Marquee Sign.

1. Base Bid: No Work.
2. Alternate: Add Installation pricing for the 10 MM LED marquee sign as specified in Section 116660 “Exterior Marquee LED Signage.” Provide separate line items on the Bid Form for each manufacturer as follows:

    a. 2A: LED Partners
    b. 2B: Daktronics
    c. 2C: Spectrum - Watchfire

C. Alternate No. 3. Chiller.

1. Base Bid: No Work.
2. Alternate: Add removal and replacement of existing chiller in existing Central Utility Plant as shown on the Drawings and as specified in Section 236426 “Rotary Screw Water Chillers.” Provide pricing for manufacturers as separate line items on the Bid Form as follows:

    a. 3A: Daikin.
    b. 3B: Trane.
    c. 3C: Carrier.

D. Alternate No. 4: Campus Communication System.

1. Base Bid: Remove and replace existing Campus Communication System head-end equipment and extend system into new Gym Addition as indicated on the Drawings and as specified in Section 275100 “Distributed Communication Systems.”
2. Alternate: Add removal and replacement of the remainder of the existing Campus Communication System in existing school as indicated on the Drawings and as specified in Section 275100 “Distributed Communication Systems.”

E. Alternate No. 5: (Not Used).

F. Alternate No. 6: (Not Used).

G. Alternate No. 7: Fire Alarm.

1. Base Bid: Extend existing fire alarm system into the new Gym Addition as shown on the Drawings and as specified in Section 284609 "Fire Alarm System with Voice Evacuation."
2. Alternate: Deduct Base Bid Work and add removal of existing fire alarm system and installation of new fire alarm system throughout existing school and Gym Addition as indicated on the Drawings and as specified in Section 284609.01 "Fire Alarm System with Voice Evacuation with Alternate." Provide pricing for manufacturers as separate line items on the Bid Form as follows:

    a. 7A: Edwards System Technology (EST 4) by Wilson Fire.
    b. 7B: Siemens by Fire-Safe.
    c. 7C: Notifier by Fire-Tron.

.END OF SECTION 012300

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SECTION 012500 - SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for substitutions after award of Contract.

B. Related Requirements:

1. Document 002600 "Procurement Substitution Procedures" for requirements for substitution requests prior to award of Contract.
2. Section 012300 "Alternates" for products selected under an alternate.
3. Section 016000 "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.

1.3 DEFINITIONS

A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents.

1. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
2. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required to meet other Project requirements but may offer advantage to Contractor or Owner.

1.4 ACTION SUBMITTALS

A. Substitution Requests: Submit documentation identifying product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.

1. Substitution Request Form: Use form provided in Project Manual at the end of this Section.
2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:

a. Statement indicating why specified product or fabrication or installation method cannot be provided, if applicable.
b. Coordination of information, including a list of changes or revisions needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate proposed substitution.
c. Detailed comparison of significant qualities of proposed substitutions with those of the Work specified. Include annotated copy of applicable Specification Section. Significant qualities may include attributes, such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.
d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
e. Samples, where applicable or requested.
f. Certificates and qualification data, where applicable or requested.
g. List of similar installations for completed projects, with project names and addresses as well as names and addresses of architects and owners.
h. Material test reports from a qualified testing agency, indicating and interpreting test results for compliance with requirements indicated.
i. Research reports evidencing compliance with building code in effect for Project, from ICC-ES.
j. Detailed comparison of Contractor's construction schedule using proposed substitutions with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
k. Cost information, including a proposal of change, if any, in the Contract Sum.
l. Contractor's certification that proposed substitution complies with requirements in the Contract Documents, except as indicated in substitution request, is compatible with related materials and is appropriate for applications indicated.
m. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.

3. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within seven days of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of proposed substitution within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.

a. Forms of Acceptance: Change Order, Construction Change Directive, or Architect's Supplemental Instructions for minor changes in the Work.
b. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.

1.5 QUALITY ASSURANCE

A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage a qualified testing agency to perform compatibility tests recommended by manufacturers.

1.6 PROCEDURES

A. Coordination: Revise or adjust affected work as necessary to integrate work of the approved substitutions.

1.7 SUBSTITUTIONS

A. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than 15 days prior to time required for preparation and review of related submittals.

1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:

a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
b. Substitution request is fully documented and properly submitted.
c. Requested substitution will not adversely affect Contractor's construction schedule.
d. Requested substitution has received necessary approvals of authorities having jurisdiction.
e. Requested substitution is compatible with other portions of the Work.
f. Requested substitution has been coordinated with other portions of the Work.
g. Requested substitution provides specified warranty.
h. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

B. Substitutions for Convenience: Not allowed unless otherwise indicated unless construction schedule advantage or cost savings to Owner.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012500

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POST-BID REQUEST FOR SUBSTITUTION FORM 012500A

To: DLR Group inc.
1000 Louisiana Street, Suite 1100
Houston, Texas 77002
TEL: (713) 561-3925

PROJECT: _____

CONTRACTOR'S REQUEST, WITH SUPPORTING DATA

1. Reason for Substitution Request: _____

_____

2. Specifications to which this request applies: _____ _____ _____
Section *Page* *Paragraph*

☐ Product Data for proposed substitution is attached (description of product, reference standards, performance and test data).

☐ Sample is attached. ☐ Sample will be sent if requested by Architect/Engineer.

3. Itemized comparison of proposed substitution with product specified:

	ORIGINAL PRODUCT	PROPOSED SUBSTITUTION
Name, brand:		
Catalog No.:		
Manufacturer:		
Significant Variations:		

4. Unit costs of original product and proposed substitution. State whether cost is for

☐ material only, ☐ material installed, or ☐ Life Cycle cost of installed product.

Original Product: $_____ per _____ Substitution: $_____ per _____

5. Proposed change in Contract Sum:
Credit to Owner: $_____ Additional Cost to Owner: $ _____

6. Proposed Change in Contract Time: ☐ Reduce ☐ Increase by _____ days.

7. Effect of proposed substitution on other parts of the Work, or on other Contracts:

_____
_____
_____
_____

CONTRACTOR'S STATEMENT
OF CONFORMANCE
OF PROPOSED SUBSTITUTION TO CONTRACT DOCUMENTS

I/we have investigated the proposed substitution. I/we:

1. believe that it is equal or superior in all respects to the originally specified product, except as stated in 3. above;
2. will provide the same warranty as required in AIA A201 General Conditions 3.5.1;
3. will provide the same special warranty or guaranty as specified;
4. have included all cost data and cost implications of the proposed substitution;
5. will pay redesign and special inspection costs caused by the use of this product;
6. will pay additional costs to other contractors caused by the substitution;
7. will coordinate the incorporation of the proposed substitution in the Work;
8. will modify other parts of the Work as may be needed, to make all parts of the Work complete and functioning;
9. waive future claims for added cost to Contractor caused by the proposed substitution.

Contractor: _____ Date: _____
(Signature)

Firm: _____

ARCHITECT/ENGINEER'S REVIEW AND ACTION

☐ Provide more information in the following categories. Resubmit.

_____

_____

☐ Sign Contractor's Statement of Conformance. Resubmit.

☐ The proposed substitution is approved, with the following conditions:

_____

_____

☐ The proposed substitution is rejected, use specified materials:

_____

_____

The following changes will be made by Change Order:

Addition to / deduction from the Contract Sum: $_____

Addition to / deduction from the Contract Time: _____ days.

DLR Group inc.

By _____ Date: _____
(Signature)

SECTION 012600 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for handling and processing Contract modifications.

B. Related Requirements:

1. Section 012500 "Substitution Procedures" for administrative procedures for handling requests for substitutions made after the Contract award.
2. Section 013100 "Project Management and Coordination" for requirements for forms for contract modifications provided as part of web-based Project management software.

1.3 MINOR CHANGES IN THE WORK

A. Architect will issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on AIA Document G710.

1.4 PROPOSAL REQUESTS

A. Owner-Initiated Proposal Requests: Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.

1. Work Change Proposal Requests issued by Architect are not instructions either to stop work in progress or to execute the proposed change.
2. Within time specified in Proposal Request after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.

a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
c. Include costs of labor and supervision directly attributable to the change.

d. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
e. Quotation Form: Use forms acceptable to Architect.

B. Contractor-Initiated Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to Architect.

1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
4. Include costs of labor and supervision directly attributable to the change.
5. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
6. Comply with requirements in Section 012500 "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.
7. Proposal Request Form: Use form acceptable to Architect.

1.5 CHANGE ORDER PROCEDURES

A. On Owner's approval of a Work Change Proposal Request, Architect will issue a Change Order for signatures of Owner and Contractor on AIA Document G701.

1.6 CONSTRUCTION CHANGE DIRECTIVE

A. Construction Change Directive: Architect may issue a Construction Change Directive on AIA Document G714. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.

1. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.

B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.

1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012600

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SECTION 012900 - PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements necessary to prepare and process Applications for Payment.

B. Related Requirements:

1. Section 012600 "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
2. Section 013200 "Construction Progress Documentation" for administrative requirements governing the preparation and submittal of the Contractor's construction schedule.
3. Section 017700 “Closeout Procedures” for forms for release of liens, project compliance, hazardous materials, and warranty.

1.3 DEFINITIONS

A. Schedule of Values: A statement furnished by Contractor allocating portions of the Contract Sum to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

1.4 SCHEDULE OF VALUES

A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule.

1. Coordinate line items in the schedule of values with items required to be indicated as separate activities in Contractor's construction schedule.
2. Submit the schedule of values to Architect at earliest possible date, but no later than seven days before the date scheduled for submittal of initial Applications for Payment.
3. Subschedules for Phased Work: Where the Work is separated into phases requiring separately phased payments, provide subschedules showing values coordinated with each phase of payment.

B. Format and Content: Use Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one line item for each Specification Section.

1. Identification: Include the following Project identification on the schedule of values:

    a. Project name and location.
    b. Owner's name.
    c. Owner's Project number.
    d. Name of Architect.
    e. Architect's Project number.
    f. Contractor's name and address.
    g. Date of submittal.

2. Arrange schedule of values consistent with format of AIA Document G703.
3. Arrange the schedule of values in tabular form, with separate columns to indicate the following for each item listed:

    a. Related Specification Section or division.
    b. Description of the Work.
    c. Name of subcontractor.
    d. Name of manufacturer or fabricator.
    e. Name of supplier.
    f. Change Orders (numbers) that affect value.
    g. Dollar value of the following, as a percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent. Round dollar amounts to whole dollars, with total equal to Contract Sum.

        1) Labor.
        2) Materials.
        3) Equipment.

4. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Provide multiple line items for principal subcontract amounts in excess of five percent of the Contract Sum.
5. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.

    a. Differentiate between items stored on-site and items stored off-site. Include evidence of insurance.

6. Overhead Costs, Separate Line Items: Show cost of temporary facilities and other major cost items that are not direct cost of actual work-in-place as separate line items.
7. Temporary Facilities: Show cost of temporary facilities and other major cost items that are not direct cost of actual work-in-place as separate line items.
8. Closeout Costs. Include separate line items under Contractor and principal subcontracts for Project closeout requirements in an amount totaling five percent of the Contract Sum and subcontract amount.
9. Schedule of Values Revisions: Revise the schedule of values when Change Orders or Construction Change Directives result in a change in the Contract Sum. Include at least one separate line item for each Change Order and Construction Change Directive.

1.5 APPLICATIONS FOR PAYMENT

A. Each Application for Payment following the initial Application for Payment shall be consistent with previous applications and payments, as certified by Architect and paid for by Owner.

B. Payment Application Times: Submit Application for Payment to Architect by the fifth (5th) of the month. The period covered by each Application for Payment is one month, ending on the last day of the month.

1. Submit draft copy of Application for Payment seven days prior to due date for review by Architect.

C. Application for Payment Forms: Use AIA Document G702 and AIA Document G703 as form for Applications for Payment.

D. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Architect will return incomplete applications without action.

1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
2. Include amounts for work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.
3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
4. Indicate separate amounts for work being carried out under Owner-requested project acceleration.

E. Stored Materials: Include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored, but not yet installed. Differentiate between items stored on-site and items stored off-site.

1. Provide certificate of insurance, evidence of transfer of title to Owner, and consent of surety to payment for stored materials.
2. Provide supporting documentation that verifies amount requested, such as paid invoices. Match amount requested with amounts indicated on documentation; do not include overhead and profit on stored materials.
3. Provide summary documentation for stored materials indicating the following:

a. Value of materials previously stored and remaining stored as of date of previous Applications for Payment.
b. Value of previously stored materials put in place after date of previous Application for Payment and on or before date of current Application for Payment.
c. Value of materials stored since date of previous Application for Payment and remaining stored as of date of current Application for Payment.

4. Use the following forms attached to the end of this Section:

a. Off-Site Storage Agreement Form 012900A.

b. Consent of Surety Company to Off-Site Storage Agreement Form 012900B.

F. Transmittal: Submit one electronic signed and notarized original copies of each Application for Payment to Architect by a method ensuring receipt on due date. Copy shall include waivers of lien and similar attachments if required.

G. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's lien from subcontractors, sub-subcontractors, and suppliers for construction period covered by the previous application.

1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
2. When an application shows completion of an item, submit conditional final or full waivers.
3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
4. Submit final Application for Payment with or preceded by conditional final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.
5. Waiver Forms: Submit executed waivers of lien on forms acceptable to Owner.

H. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:

1. List of subcontractors.
2. Schedule of values.
3. Contractor's construction schedule (preliminary if not final).
4. Combined Contractor's construction schedule (preliminary if not final) incorporating Work of multiple contracts, with indication of acceptance of schedule by each Contractor.
5. Products list (preliminary if not final).
6. Submittal schedule (preliminary if not final).
7. List of Contractor's staff assignments.
8. List of Contractor's principal consultants.
9. Copies of building permits.
10. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
11. Initial progress report.
12. Report of preconstruction conference.
13. Certificates of insurance and insurance policies.
14. Performance and payment bonds.
15. Data needed to acquire Owner's insurance.
16. Tabulation of stored materials if any.

I. Progress Payment: Upon certification by the Architect, the Owner shall make payment not later than the thirty-fifth (35th) after receipt of Application for Payment, pay to the Contractor, on account of the Contract, ninety-five percent (95%) of the value of labor and materials incorporated in the Work and ninety five percent (95%) of materials suitably stored in accord with Subparagraph 9.3.2 of the General Conditions, up to the last day of the preceding month.

J. Application for Payment at Substantial Completion: After Architect issues the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.

1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.

    a. Complete administrative actions, submittals, and Work preceding this application, as described in Section 017700 "Closeout Procedures."

2. This application shall reflect Certificate(s) of Substantial Completion issued previously for Owner occupancy of designated portions of the Work.
3. Occupancy permits and similar approvals.
4. Warranties (guarantees) and maintenance agreements.
5. Test/adjust/balance records.
6. Maintenance instructions.
7. Meter readings.
8. Start-up performance reports.
9. Change-over information related to Owner’s occupancy, use, operation and maintenance.
10. Final cleaning.
11. Application for reduction of retainage, and consent of surety.
12. Advice on shifting insurance coverages.
13. Final progress photographs.
14. List of incomplete Work, recognized as exceptions to Architect’s Certificate of Substantial Completion.
15. Extra stock.

K. Release of Retainage after Substantial Completion: After Substantial Completion, and upon receipt of Applications for Payment accompanied by Consent of Surety to Reduction in or Partial Release of Retainage executed in duplicate on AIA Document G707A, and upon certification by the Architect, the Owner shall release retainage of the contract amount to date.

L. Final Payment Application: After completing Project closeout requirements, submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:

1. Evidence of completion of Project closeout requirements.
2. Certification of completion of final punch list items.
3. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
4. Updated final statement, accounting for final changes to the Contract Sum.
5. AIA Document G706 “Contractor’s Affidavit of Payment of Debts and Claims.”
6. AIA Document G706A “Contractor’s Affidavit of Release of Liens.”
7. AIA Document G707 "Consent of Surety to Final Payment."
8. Evidence that claims have been settled.
9. Final meter readings for utilities and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
10. Final liquidated damages settlement statement.

11. Certification stating that no asbestos was used in the manufacture or fabrication of products and materials used in the construction of this Project.
12. Proof that taxes, fees, and similar obligations are paid.
13. Waivers and releases.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012900

OFF-SITE STORAGE AGREEMENT FORM

OFF-SITE STORAGE AGREEMENT

made this _____ day of _____ in the year two thousand and _____.

Between the **Owner**: _____
(Name and Address)

and the **Contractor**: _____
(Name and Address)

the **Project**: _____
(Name, Address and Project Number)

The Owner and the Contractor understand and agree that a portion of the Total Completed and Stored To Date shown on Application for Payment No. _____ represents an amount for material to be furnished and installed under their

Agreement dated _____, 20 _____, and that this material is to be stored at

_____

_____,
(Storage Location)

a location other than the site, under the following conditions:

1. Materials stored at the above location shall be plainly tagged or marked by the Contractor as Property of

_____.
(Owner)

2. Such materials shall be separately located and segregated by the Contractor from other materials at the place of storage.

3. Such materials shall be kept free of any liens or encumbrances by the Contractor, and shall be kept adequately insured against loss to the Owner by theft, fire, or other casualty at the expense of the Contractor, and proof of such insurance will be furnished to the Owner.

4. Such material shall be stored as herein provided and moved to the site without delaying the Work and without expense to the Owner.

5. Consent of Surety to enter into the Off-Site Storage Agreement shall be furnished to the Owner.

Owner Contractor

(Sign same as Agreement)

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CONSENT OF SURETY COMPANY TO OFF-SITE STORAGE AGREEMENT FORM

OWNER ☐
ARCHITECT ☐
CONTRACTOR ☐
SURETY ☐
OTHER

PROJECT:
(Name, Address)

TO (Owner)
[ ] ARCHITECT'S PROJECT NO.
CONTRACT FOR:

[ ] CONTRACT DATE:
CONTRACTOR:

In accordance with the provisions of the Contract between the Owner and the Contractor as indicated above, the (here insert name and address of Surety Company)

, SURETY COMPANY,

on bond of (here insert name and address of Contractor)

, CONTRACTOR,

hereby approves the attached off-site agreement with the Contractor, and agrees that off-site storage agreement shall not relieve the Surety Company of any of its obligations to (here insert name and address of Owner)

, OWNER ,

as set forth in the said Surety Company's bond.

IN WITNESS WHEREOF,
the Surety Company has hereunto set its hand this day of 20

Surety Company

Signature of Authorized Representative

Attest:
(Seal):

Title

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SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative provisions for coordinating construction operations on Project, including, but not limited to, the following:

1. General coordination procedures.
2. Coordination drawings.
3. RFIs.
4. Digital project management procedures.
5. Web-based Project management software package.
6. Project meetings.

B. Each contractor shall participate in coordination requirements. Certain areas of responsibility are assigned to a specific contractor.

C. Related Requirements:

1. Section 013200 "Construction Progress Documentation" for preparing and submitting Contractor's construction schedule.
2. Section 017300 "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
3. Section 017700 "Closeout Procedures" for coordinating closeout of the Contract.
4. Section 019113 "General Commissioning Requirements" for coordinating the Work with Owner's Commissioning Authority.

1.3 DEFINITIONS

A. BIM: Building Information Modeling.

B. RFI: Request for Information. Request from Contractor seeking information required by or clarifications of the Contract Documents.

1.4 INFORMATIONAL SUBMITTALS

A. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:

1. Name, address, telephone number, and email address of entity performing subcontract or supplying products.
2. Number and title of related Specification Section(s) covered by subcontract.
3. Drawing number and detail references, as appropriate, covered by subcontract.

B. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses, cellular telephone numbers, and e-mail addresses. Provide names, addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project.

1. Post copies of list in Project meeting room, in temporary field office, in web-based Project software directory, and in prominent location inbuilt facility. Keep list current at all times.

1.5 GENERAL COORDINATION PROCEDURES

A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations included in different Sections that depend on each other for proper installation, connection, and operation.

1. Schedule construction operations in sequence required to obtain the best results, where installation of one part of the Work depends on installation of other components, before or after its own installation.
2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
3. Make adequate provisions to accommodate items scheduled for later installation.

B. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.

1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.

C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities and scheduled activities of other contractors to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:

1. Preparation of Contractor's construction schedule.
2. Preparation of the schedule of values.

3. Installation and removal of temporary facilities and controls.
4. Delivery and processing of submittals.
5. Progress meetings.
6. Preinstallation conferences.
7. Project closeout activities.
8. Startup and adjustment of systems.

1.6 COORDINATION DRAWINGS

A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely indicated on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.

1. Provide Coordination Drawings for the following items, rooms or spaces:

    a. Gymnasium.

2. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:

    a. Use applicable Drawings as a basis for preparation of coordination drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.
    b. Coordinate the addition of trade-specific information to coordination drawings by multiple contractors in a sequence that best provides for coordination of the information and resolution of conflicts between installed components before submitting for review.
    c. Indicate functional and spatial relationships of components of architectural, structural, mechanical, and electrical systems.
    d. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
    e. Show location and size of access doors required for access to concealed dampers, valves, and other controls.
    f. Indicate required installation sequences.
    g. Indicate dimensions shown on Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternative sketches to Architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.

B. Coordination Drawing Organization: Organize coordination drawings as follows:

1. Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing, fire-protection, fire-alarm, and electrical Work. Show locations of visible ceiling-mounted devices relative to acoustical ceiling grid. Supplement plan drawings with section drawings where required to adequately represent the Work.

2. Structural Penetrations: Indicate penetrations and openings required for all disciplines.
3. Mechanical and Plumbing Work: Show the following:

    a. Sizes and bottom elevations of ductwork, piping, and conduit runs, including insulation, bracing, flanges, and support systems.
    b. Dimensions of major components, such as dampers, valves, diffusers, access doors, cleanouts and electrical distribution equipment.

4. Electrical Work: Show the following:

    a. Runs of vertical and horizontal conduit 1-1/4 inches in diameter and larger.
    b. Light fixture, exit light, emergency battery pack, smoke detector, and other fire-alarm locations.
    c. Location of pull boxes and junction boxes, dimensioned from column center lines.

5. Fire-Protection System: Show the following:

    a. Locations of standpipes, mains piping, branch lines, pipe drops, and sprinkler heads.

6. Review: Architect will review coordination drawings to confirm that, in general, the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility. If Architect determines that coordination drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, Architect will so inform Contractor, who shall make suitable modifications and resubmit.
7. Coordination Drawing Prints: Prepare coordination drawing prints according to requirements in Section 013300 "Submittal Procedures."

C. Coordination Drawing Process: Prepare coordination drawings in the following manner:

1. Schedule submittal and review of Fire Sprinkler, Plumbing, HVAC, and Electrical Shop Drawings to make required changes prior to preparation of coordination drawings.
2. Commence routing of coordination drawing files with HVAC Installer, who will provide drawing plan files denoting approved ductwork. HVAC Installer will locate ductwork and piping on a single layer, using orange color. Forward drawings to Plumbing Installer.
3. Plumbing Installer will locate plumbing and equipment on a single layer, using blue color.
4. Fire Sprinkler Installer will locate piping and equipment, using red color. Fire Sprinkler Installer shall forward drawing files to Electrical Installer.
5. Electrical Installer will indicate service and feeder conduit runs and equipment in green color. Electrical Installer shall forward drawing files to Communications and Electronic Safety and Security Installer.
6. Communications and Electronic Safety and Security Installer will indicate cable trays and cabling runs and equipment in purple color. Communications and Electronic Safety and Security Installer shall forward completed drawing files to Contractor.
7. Contractor shall perform the final coordination review. As each coordination drawing is completed, Contractor will meet with Architect to review and resolve conflicts on the coordination drawings.

1.7 REQUEST FOR INFORMATION (RFI)

A. General: Immediately on discovery of the need for additional information, clarification, or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.

1. Architect will return without response those RFIs submitted to Architect by other entities controlled by Contractor.
2. Coordinate and submit RFIs in a prompt manner to avoid delays in Contractor's work or work of subcontractors.

B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:

1. Project name.
2. Owner name.
3. Owner's Project number.
4. Name of Architect.
5. Architect's Project number.
6. Date.
7. Name of Contractor.
8. RFI number, numbered sequentially.
9. RFI subject.
10. Specification Section number and title and related paragraphs, as appropriate.
11. Drawing number and detail references, as appropriate.
12. Field dimensions and conditions, as appropriate.
13. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
14. Contractor's signature.
15. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.

    a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.

C. RFI Forms: Software-generated form with substantially the same content as indicated above, acceptable to Architect.

1. Attachments shall be electronic files in PDF format.

D. Architect's Action: Architect will review each RFI, determine action required, and respond. Allow seven days for Architect's response for each RFI. RFIs received by Architect after 1:00 p.m. will be considered as received the following working day.

1. The following Contractor-generated RFIs will be returned without action:

    a. Requests for approval of submittals.
    b. Requests for approval of substitutions.
    c. Requests for approval of Contractor's means and methods.

d. Requests for coordination information already indicated in the Contract Documents.
e. Requests for adjustments in the Contract Time or the Contract Sum.
f. Requests for interpretation of Architect's actions on submittals.
g. Incomplete RFIs or inaccurately prepared RFIs.

2. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt by Architectof additional information.

a. For resubmittals use the original RFI No. followed by a new sequence number (i.e. RFI-01-01 for first resubmittal of RFI-01; RFI-01-02 for second resubmittal and so on until RFI is approved).

3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Section 012600 "Contract Modification Procedures."

a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within 3 days of receipt of the RFI response.
b. An RFI response, is not a written authorization to proceed with any contract modification.

E. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log bi-weekly or at regularly scheduled progress meetings. Use software log that is part of web-based Project management software. Software log with not less than the following:

1. Project name.
2. Name and address of Contractor.
3. Name and address of Architect.
4. RFI number, including RFIs that were returned without action or withdrawn.
5. RFI description.
6. Date the RFI was submitted.
7. Date Architect's response was received.
8. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.

F. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect and Construction Manager within three days if Contractor disagrees with response.

1.8 DIGITAL PROJECT MANAGEMENT PROCEDURES

A. Use of Architect's Digital Data Files: Digital data files of Architect's BIM model will be provided by Architect for Contractor's use during construction.

1. Digital data files may be used by Contractor in preparing coordination drawings, Shop Drawings, and Project Record Drawings.

2. Architect makes no representations as to the accuracy or completeness of digital data files as they relate to Contract Drawings.
3. Digital Drawing Software Program: Contract Drawings are available in Revit 2024.
4. Contractor shall execute a data licensing agreement in the form of AIA Document C106 Digital Data Licensing Agreement.

    a. Subcontractors and other parties granted access by Contractor to Architect's digital data files shall execute a data licensing agreement in the form of AIA Document C106. Form included at the end of this Section.

5. The Architect, if requested after the Bid Date, will provide the Contractor with one (1) electronic copy of the Contract Document Drawings for distribution to subcontractors and suppliers. One (1) electronic copy will be provided in Portable Document Format (PDF) and one (1) electronic copy in Revit 2024. Fee for the electronic copies shall be as follows:

    a. Electronic files will be released upon receipt of payment and the Digital Licensing Agreement form AIA Document C106 included at the end of this Section.

B. Web-Based Project Management Software Package: Use Architect's web-based Project management software package for purposes of hosting and managing Project communication and documentation until Final Completion.

1. Web-based Project management software includes, at a minimum, the following features:

    a. Compilation of Project data, including Contractor, subcontractors, Architect, Architect's consultants, Owner, and other entities involved in Project. Include names of individuals and contact information.
    b. Access control for each entity for each workflow process, to determine entity's digital rights to create, modify, view, and print documents.
    c. Document workflow planning, allowing customization of workflow between project entities.
    d. Creation, logging, tracking, and notification for Project communications required in other Specification Sections, including, but not limited to, RFIs, submittals, Minor Changes in the Work, Construction Change Directives, and Change Orders.
    e. Track status of each Project communication in real time, and log time and date when responses are provided.
    f. Procedures for handling PDFs or similar file formats, allowing markups by each entity. Provide security features to lock markups against changes once submitted.
    g. Processing and tracking of payment applications.
    h. Processing and tracking of contract modifications.
    i. Creating and distributing meeting minutes.
    j. Document management for Drawings, Specifications, and coordination drawings, including revision control.
    k. Management of construction progress photographs.
    l. Mobile device compatibility, including smartphones and tablets.

C. PDF Document Preparation: Where PDFs are required to be submitted to Architect, prepare as follows:

1. Assemble complete submittal package into a single indexed file, incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
2. Name file with submittal number or other unique identifier, including revision identifier.
3. Certifications: Where digitally submitted certificates and certifications are required, provide a digital signature with digital certificate on where indicated.

1.9 PROJECT MEETINGS

A. General: Schedule and conduct meetings and conferences at Project site unless otherwise indicated.

1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times a minimum of seven days prior to meeting.
2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within three days of the meeting.

B. Preconstruction Conference: Architect will schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than 15 days after execution of the Agreement.

1. Attendees: Authorized representatives of Owner, Owner's Commissioning Authority, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
2. Agenda: Discuss items of significance that could affect progress, including the following:

    a. Responsibilities and personnel assignments.
    b. Tentative construction schedule.
    c. Phasing.
    d. Critical work sequencing and long lead items.
    e. Designation of key personnel and their duties.
    f. Lines of communications.
    g. Use of web-based Project software.
    h. Procedures for processing field decisions and Change Orders.
    i. Procedures for RFIs.
    j. Procedures for testing and inspecting.
    k. Procedures for processing Applications for Payment.
    l. Distribution of the Contract Documents.
    m. Submittal procedures.
    n. Sustainable design requirements.
    o. Preparation of Record Documents.
    p. Use of the premises and existing building.
    q. Work restrictions.
    r. Working hours.

s. Owner's occupancy requirements.
t. Responsibility for temporary facilities and controls.
u. Procedures for moisture and mold control.
v. Procedures for disruptions and shutdowns.
w. Construction waste management and recycling.
x. Parking availability.
y. Office, work, and storage areas.
z. Equipment deliveries and priorities.
aa. First aid.
bb. Security.
cc. Progress cleaning.
dd. Testing and Special Inspection procedures.

3. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.

C. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity when required by other Sections and when required for coordination with other construction.

1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect, and Owner's Commissioning Authority of scheduled meeting dates.
2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:

a. Contract Documents.
b. Options.
c. Related RFIs.
d. Related Change Orders.
e. Purchases.
f. Deliveries.
g. Submittals.
h. Sustainable design requirements.
i. Review of mockups.
j. Possible conflicts.
k. Compatibility requirements.
l. Time schedules.
m. Weather limitations.
n. Manufacturer's written instructions.
o. Warranty requirements.
p. Compatibility of materials.
q. Acceptability of substrates.
r. Temporary facilities and controls.
s. Space and access limitations.
t. Regulations of authorities having jurisdiction.
u. Testing and inspecting requirements.
v. Installation procedures.
w. Coordination with other work.

x. Required performance results.
y. Protection of adjacent work.
z. Protection of construction and personnel.

3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
4. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.
5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.

D. Project Closeout Conference: Schedule and conduct a project closeout conference, at a time convenient to Owner and Architect, but no later than 90 days prior to the scheduled date of Substantial Completion.

1. Conduct the conference to review requirements and responsibilities related to Project closeout.
2. Attendees: Authorized representatives of Owner, Owner's Commissioning Authority, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the meeting. Participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
3. Agenda: Discuss items of significance that could affect or delay Project closeout, including the following:

a. Preparation of Record Documents.
b. Procedures required prior to inspection for Substantial Completion and for final inspection for acceptance.
c. Procedures for completing and archiving web-based Project software site data files.
d. Submittal of written warranties.
e. Requirements for preparing operations and maintenance data.
f. Requirements for delivery of material samples, attic stock, and spare parts.
g. Requirements for demonstration and training.
h. Preparation of Contractor's punch list.
i. Procedures for processing Applications for Payment at Substantial Completion and for final payment.
j. Submittal procedures.
k. Coordination of separate contracts.
l. Owner's partial occupancy requirements.
m. Installation of Owner's furniture, fixtures, and equipment.
n. Responsibility for removing temporary facilities and controls.

4. Minutes: Entity conducting meeting will record and distribute meeting minutes.

E. Progress Meetings: Conduct progress meetings at monthly intervals.

1. Coordinate dates of meetings with preparation of payment requests.

2. Attendees: In addition to representatives of Owner, Owner's Commissioning Authority and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
3. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.

    a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.

        1) Review schedule for next period.

    b. Review present and future needs of each entity present, including the following:

        1) Interface requirements.
        2) Sequence of operations.
        3) Status of submittals.
        4) Deliveries.
        5) Off-site fabrication.
        6) Access.
        7) Site use.
        8) Temporary facilities and controls.
        9) Progress cleaning.
        10) Quality and work standards.
        11) Status of correction of deficient items.
        12) Field observations.
        13) Status of RFIs.
        14) Status of Proposal Requests.
        15) Pending changes.
        16) Status of Change Orders.
        17) Pending claims and disputes.
        18) Documentation of information for payment requests.

4. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.

    a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting, where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

F. Coordination Meetings: Conduct Project coordination meetings at regular intervals. Project coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and preinstallation conferences.

1. Attendees: In addition to representatives of Owner, Owner's Commissioning Authority and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meetings shall be familiar with Project and authorized to conclude matters relating to the Work.
2. Agenda: Review and correct or approve minutes of the previous coordination meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.

    a. Combined Contractor's Construction Schedule: Review progress since the last coordination meeting. Determine whether each contract is on time, ahead of schedule, or behind schedule, in relation to combined Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
    b. Schedule Updating: Revise combined Contractor's construction schedule after each coordination meeting, where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with report of each meeting.
    c. Review present and future needs of each contractor present, including the following:

        1) Interface requirements.
        2) Sequence of operations.
        3) Status of submittals.
        4) Deliveries.
        5) Off-site fabrication.
        6) Access.
        7) Site use.
        8) Temporary facilities and controls.
        9) Work hours.
        10) Hazards and risks.
        11) Progress cleaning.
        12) Quality and work standards.
        13) Status of RFIs.
        14) Proposal Requests.
        15) Change Orders.
        16) Pending changes.

3. Reporting: Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013100

AIA® Document C106™ – 2022

Digital Data Licensing Agreement

AGREEMENT made as of the day of in the year
(In words, indicate day, month, and year.)

BETWEEN the Party transmitting Digital Data ("Transmitting Party"):
(Name, address, and contact information, including electronic addresses)

and the Party receiving the Digital Data ("Receiving Party"):
(Name, address, and contact information, including electronic addresses)

Company legal name

for the following Project:
(Name and location or address of the Project)

Klein ISD – Schindewolf Gym Addition
20903 Ella Boulevard
Spring, TX 77388

for the following Digital Data ("Digital Data"):
(Identify below, in detail, the information created or stored in digital form that the Parties intend to be subject to this Agreement.)

All digital data files transmitted between the parties for the Work of this Project.

The Transmitting Party and Receiving Party agree as follows.

TABLE OF ARTICLES

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.

ARTICLE 1 GENERAL PROVISIONS

§ 1.1 The purpose of this Agreement is to grant a license from the Transmitting Party to the Receiving Party for the Receiving Party's use of Digital Data and to set forth the license terms.

§ 1.2 This Agreement is the entire and integrated agreement between the Parties. Except as specifically set forth herein, this Agreement does not create any other contractual relationship between the Parties.

§ 1.3 Confidential Digital Data is Digital Data containing confidential or business proprietary information that the Transmitting Party designates as "confidential."

ARTICLE 2 TRANSMISSION OF DIGITAL DATA

§ 2.1 The Transmitting Party grants to the Receiving Party a nonexclusive limited license to use the Digital Data solely and exclusively for the uses, and in accordance with the terms, set forth in Article 3.

§ 2.2 Only the Receiving Party is permitted to access and use the Digital Data. Unlicensed and unauthorized access or use by third parties is strictly prohibited except as set forth in Section 2.4.1.

§ 2.3 The transmission of Digital Data constitutes a warranty by the Transmitting Party to the Receiving Party that the Transmitting Party is the copyright owner of the Digital Data or otherwise has permission to transmit the Digital Data to the Receiving Party for its use on the Project in accordance with the terms and conditions of this Agreement.

§ 2.4 Where the Transmitting Party has designated information furnished pursuant to this Agreement as "confidential," the Receiving Party shall keep the information confidential and shall not disclose it to any other person or entity except as set forth in Section 2.4.1.

§ 2.4.1 The Receiving Party may disclose Confidential Digital Data after seven (7) days' notice to the Transmitting Party where disclosure is required by law, including a subpoena or other form of compulsory legal process issued by a court or governmental entity, or by court or arbitrator(s) order. The Receiving Party may also disclose Confidential Digital Data to its employees, consultants, sureties, subcontractors and their employees, sub-subcontractors, and others who need to know the content of such information solely and exclusively for the Project and who agree to maintain the confidentiality of such information.

§ 2.5 By transmitting Digital Data, the Transmitting Party does not convey any ownership right in the Digital Data or in the software used to generate the Digital Data. Unless otherwise granted in a separate license, the Receiving Party's right to use, modify, or further transmit Digital Data is specifically limited to those uses, and in accordance with the terms, set forth in Article 3, and nothing contained in this Agreement conveys any other right to use the Digital Data.

§ 2.6 To the fullest extent permitted by law, the Receiving Party shall indemnify and defend the Transmitting Party from and against all claims arising from or related to the Receiving Party's modification to, or unlicensed use of, the Digital Data.

§ 2.7 Transmission of the Digital Data does not abridge or extinguish the Transmitting Party's rights, including, to the extent applicable, exclusive ownership interest, in such information under all applicable state, federal, and international laws including, without limitation, laws governing the protection of copyrights and intellectual property.

§ 2.8 The provisions of this Article 2 shall survive the termination of this Agreement.

ARTICLE 3 LICENSE CONDITIONS

§ 3.1 The Receiving Party may use and rely upon the Digital Data to the extent set forth in this Article 3.
(Choose only one option below.)

[X] **§ 3.1.1** The Digital Data is transmitted solely for the Receiving Party's information. Receiving Party acknowledges that any use of the Digital Data shall be at Receiving Party's sole risk. The Receiving Party accepts the Digital Data "as is" without any warranty or representations from the Transmitting Party as to whether the Digital Data is accurate, complete, or fit for use as intended by the Receiving Party. The Receiving Party is solely responsible for verifying whether the Digital Data is accurate, complete, or fit for the Receiving Party's intended use.

[ ] **§ 3.1.2** Other:
(Identify terms, permitted uses, or other conditions related to the Digital Data.)

§ 3.2 If no specific terms or uses are selected or set forth in Section 3.1, then the Receiving Party may use the Digital Data at its sole risk pursuant to the terms and conditions set forth in Section 3.1.1.

ARTICLE 4 LICENSING FEE OR OTHER COMPENSATION

The Receiving Party agrees to pay the Transmitting Party the following fee or other compensation for the Receiving Party's use of the Digital Data:
(State the fee, in dollars, or other method by which the Receiving Party will compensate the Transmitting Party for the Receiving Party's use of the Digital Data.)

There will be no compensation for the digital data files transmitted between the parties for the Work of this Project.

This Agreement is entered into as of the day and year first written above and terminates one year from the Substantial Completion date of the Project.
(Indicate when this Agreement will terminate, if other than one year from the date it was entered into, and other conditions related to termination.)

TRANSMITTING PARTY *(Signature)*	**RECEIVING PARTY** *(Signature)*
(Printed name and title)	*(Printed name and title)*

Additions and Deletions Report for

AIA® Document C106™ – 2022

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

Note: This Additions and Deletions Report is provided for information purposes only and is not incorporated into or constitute any part of the associated AIA document. This Additions and Deletions Report and its associated document were generated simultaneously by AIA software at 12:08:29 ET on 01/09/2025.

PAGE 1

Company legal name

...

(Name and location or address of the Project)

Klein ISD – Schindewolf Gym Addition
20903 Ella Boulevard
Spring, TX 77388

...

All digital data files transmitted between the parties for the Work of this Project.

PAGE 2

[X] **§ 3.1.1** The Digital Data is transmitted solely for the Receiving Party's information. Receiving Party acknowledges that any use of the Digital Data shall be at Receiving Party's sole risk. The Receiving Party accepts the Digital Data "as is" without any warranty or representations from the Transmitting Party as to whether the Digital Data is accurate, complete, or fit for use as intended by the Receiving Party. The Receiving Party is solely responsible for verifying whether the Digital Data is accurate, complete, or fit for the Receiving Party's intended use.

PAGE 3

There will be no compensation for the digital data files transmitted between the parties for the Work of this Project.

This Agreement is entered into as of the day and year first written above and terminates one year from ~~said date, except as set forth below.~~the Substantial Completion date of the Project.

Certification of Document's Authenticity

AIA® Document D401™ – 2003

I, , hereby certify, to the best of my knowledge, information and belief, that I created the attached final document simultaneously with its associated Additions and Deletions Report and this certification at 12:08:29 ET on 01/09/2025 under Order No. 3104241897 from AIA Contract Documents software and that in preparing the attached final document I made no changes to the original text of AIA® Document C106™ – 2022, Digital Data Licensing Agreement, other than those additions and deletions shown in the associated Additions and Deletions Report.

_____

(Signed)

_____

(Title)

_____

(Dated)

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SECTION 013200 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:

1. Startup construction schedule.
2. Contractor's Construction Schedule.
3. Construction schedule updating reports.
4. Field bar chart schedule.
5. Daily construction reports.
6. Site condition reports.
7. Unusual event reports.

B. Related Requirements:

1. Section 014000 "Quality Requirements" for schedule of tests and inspections.
2. Section 012900 "Payment Procedures" for schedule of values and requirements for use of cost-loaded schedule for Applications for Payment.

1.3 DEFINITIONS

A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction Project. Activities included in a construction schedule consume time and resources.

1. Critical Activity: An activity on the critical path that must start and finish on the planned early start and finish times.
2. Predecessor Activity: An activity that precedes another activity in the network.
3. Successor Activity: An activity that follows another activity in the network.

1.4 INFORMATIONAL SUBMITTALS

A. Format for Submittals: Submit required submittals in the following format:

1. PDF file.

B. Startup construction schedule.

C. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.

D. Construction Schedule Updating Reports: Submit with Applications for Payment.

E. Field Bar Chart Schedule: Submit at progress meetings.

F. Daily Construction Reports: Submit at weekly intervals.

G. Site Condition Reports: Submit at time of discovery of differing conditions.

H. Unusual Event Reports: Submit at time of unusual event.

I. Qualification Data: For scheduling consultant.

1.5 QUALITY ASSURANCE

1.6 COORDINATION

A. Coordinate Contractor's Construction Schedule with the schedule of values, list of subcontracts, submittal schedule, progress reports, payment requests, and other required schedules and reports.

1. Secure time commitments for performing critical elements of the Work from entities involved.
2. Coordinate each construction activity in the network with other activities, and schedule them in proper sequence.

1.7 CONTRACTOR'S CONSTRUCTION SCHEDULE

A. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules.

B. Time Frame: Extend schedule from date established for commencement of the Work to date of Substantial Completion and Final Completion.

1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.

C. Activities: Treat each floor or separate area as a separate numbered activity for each main element of the Work. Comply with the following:

1. Activity Duration: Define activities so no activity is longer than 21 days, unless specifically allowed by Architect.
2. Temporary Facilities: Indicate start and completion dates for the following as applicable:

a. Securing of approvals and permits required for performance of the Work.
b. Temporary facilities.
c. Construction of mock-ups, prototypes and samples.
d. Owner interfaces and furnishing of items.
e. Interfaces with Separate Contracts.
f. Regulatory agency approvals.
g. Punch list.

3. Procurement Activities: Include procurement process activities for the following long lead-time items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
4. Submittal Review Time: Include review and resubmittal times indicated in Section 013300 "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's Construction Schedule with submittal schedule.
5. Startup and Testing Time: Include no fewer than 15 days for startup and testing.
6. Commissioning Time: Include no fewer than 15 days for commissioning.
7. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Architect's administrative procedures necessary for certification of Substantial Completion.
8. Punch List and Final Completion: Include not more than 60 days for completion of punch list items and Final Completion.

D. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.

1. Work under More Than One Contract: Include a separate activity for each contract.
2. Work by Owner: Include a separate activity for each portion of the Work performed by Owner.
3. Owner-Furnished Products: Include a separate activity for each product. Include delivery date indicated in Section 011000 "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
4. Work Restrictions: Show the effect of the following items on the schedule:

a. Coordination with existing construction.
b. Limitations of continued occupancies.
c. Partial occupancy before Substantial Completion.
d. Seasonal variations.
e. Environmental control.

5. Work Stages: Indicate important stages of construction for each major portion of the Work, including, but not limited to, the following:

a. Subcontract awards.
b. Submittals.
c. Purchases.
d. Mockups.
e. Fabrication.
f. Sample testing.
g. Deliveries.

h. Installation.
i. Tests and inspections.
j. Adjusting.
k. Curing.
l. Startup and placement into final use and operation.
m. Commissioning.

6. Construction Areas: Identify each major area of construction for each major portion of the Work. Indicate where each construction activity within a major area must be sequenced or integrated with other construction activities to provide for the following:

a. Structural completion.
b. Temporary enclosure and space conditioning.
c. Permanent space enclosure.
d. Completion of mechanical installation.
e. Completion of electrical installation.
f. Substantial Completion.

E. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and Final Completion, and the following interim milestones:

1. Temporary enclosure and space conditioning.

F. Cost Correlation: Superimpose a cost correlation timeline, indicating planned and actual costs. On the line, show planned and actual dollar volume of the Work performed as of planned and actual dates used for preparation of payment requests.

1. See Section 012900 "Payment Procedures" for cost reporting and payment procedures.

G. Upcoming Work Summary: Prepare summary report indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:

1. Unresolved issues.
2. Unanswered Requests for Information.
3. Rejected or unreturned submittals.
4. Notations on returned submittals.
5. Pending modifications affecting the Work and the Contract Time.

H. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule at each regularly scheduled progress meeting.

1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
3. As the Work progresses, indicate Final Completion percentage for each activity.

I. Recovery Schedule: When periodic update indicates the Work is 14 or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, equipment required to achieve compliance, and date by which recovery will be accomplished.

J. Distribution: Distribute copies of approved schedule to Architect Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.

1. Post copies in Project meeting rooms and temporary field offices.
2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

1.8 STARTUP CONSTRUCTION SCHEDULE

A. Gantt-Chart Schedule: Submit startup, horizontal, Gantt-chart-type construction schedule within seven days of date established for the Notice of Award.

B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line. Outline significant construction activities for first 90 days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.

1.9 GANTT-CHART SCHEDULE REQUIREMENTS

A. Gantt-Chart Schedule: Submit a comprehensive, fully developed, horizontal, Gantt-chart-type, Contractor's Construction Schedule within 30 days of date established for the Notice of Award.

1. Base schedule on the startup construction schedule and additional information received since the start of Project.

B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line.

1. For construction activities that require three months or longer to complete, indicate an estimated completion percentage in 10 percent increments within time bar.

1.10 FIELD BAR CHART SCHEDULE

A. Bar-Chart Schedule: Throughout the progress of the Work, the Contractor shall prepare and maintain a three week manual horizontal bar chart field schedule reflecting the schedule of work activities accomplished for the previous week and the work scheduled for the forthcoming two weeks. Update the field schedule weekly.

1.11 REPORTS

A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:

1. List of subcontractors at Project site.
2. List of separate contractors at Project site.
3. Approximate count of personnel at Project site.
4. Equipment at Project site.
5. Material deliveries.
6. High and low temperatures and general weather conditions, including presence of rain or snow.
7. Testing and inspection.
8. Accidents.
9. Meetings and significant decisions.
10. Unusual events.
11. Stoppages, delays, shortages, and losses.
12. Meter readings and similar recordings.
13. Emergency procedures.
14. Orders and requests of authorities having jurisdiction.
15. Change Orders received and implemented.
16. Construction Change Directives received and implemented.
17. Services connected and disconnected.
18. Equipment or system tests and startups.
19. Partial completions and occupancies.
20. Substantial Completions authorized.

B. Site Condition Reports: Immediately on discovery of a difference between site conditions and the Contract Documents, prepare and submit a detailed report. Submit with a Request for Information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

C. Unusual Event Reports: When an event of an unusual and significant nature occurs at Project site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, responses by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner in advance when these events are known or predictable.

1. Submit unusual event reports directly to Owner within one day(s) of an occurrence. Distribute copies of report to parties affected by the occurrence.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013200

SECTION 013233 - PHOTOGRAPHIC DOCUMENTATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for the following:

1. Concealed Work photographs.
2. Periodic construction photographs.
3. Final Completion construction photographs.
4. Preconstruction video recordings.

B. Related Requirements:

1. Section 017700 "Closeout Procedures" for submitting photographic documentation as Project Record Documents at Project closeout.
2. Section 017900 "Demonstration and Training" for submitting video recordings of demonstration of equipment and training of Owner's personnel.
3. Section 024119 "Selective Demolition" for photographic documentation before selective demolition operations commence.

1.2 INFORMATIONAL SUBMITTALS

A. Key Plan: Submit key plan of Project site and building with notation of vantage points marked for location and direction of each photograph and video recording. Indicate elevation or story of construction. Include same information as corresponding photographic documentation.

B. Digital Photographs: Submit image files within three days of taking photographs.

1. Submit photos by uploading to web-based Project management software site. Include copy of key plan indicating each photograph's location and direction.
2. Identification: Provide the following information with each image description in file metadata tag:

a. Name of Project.
b. Name and contact information for photographer.
c. Name of Architect.
d. Name of Contractor.
e. Date photograph was taken.
f. Description of location, vantage point, and direction.
g. Unique sequential identifier keyed to accompanying key plan.

C. Video Recordings: Submit video recordings within seven days of recording.

1. Submit video recordings by uploading to web-based Project management software site. Include copy of key plan indicating each video's location and direction.
2. Identification: With each submittal, provide the following information in file metadata tag:

    a. Name of Project.
    b. Name and contact information for photographer.
    c. Name of Architect.
    d. Name of Contractor.
    e. Date video recording was recorded.
    f. Description of vantage point, indicating location, direction (by compass point), and elevation or story of construction.

1.3 QUALITY ASSURANCE

A. Photographer Qualifications: An individual who has been regularly engaged as a professional photographer of construction projects for not less than three years.

1.4 FORMATS AND MEDIA

A. Digital Photographs: Provide color images in JPG format, produced by a digital camera with minimum sensor size of 12 megapixels, and at an image resolution of not less than 3200 by 2400 pixels, and with vibration-reduction technology. Use flash in low light levels or backlit conditions.

B. Digital Video Recordings: Provide high-resolution, digital video in MPEG format, produced by a digital camera with minimum sensor resolution of 12 megapixels and capable of recording in full high-definition mode with vibration-reduction technology. Provide supplemental lighting in low light levels or backlit conditions.

C. Digital Images: Submit digital media as originally recorded in the digital camera, without alteration, manipulation, editing, or modifications using image-editing software.

D. Metadata: Record accurate date and time from camera.

E. File Names: Name media files with date and sequential numbering suffix.

1.5 CONSTRUCTION PHOTOGRAPHS

A. Photographer: Engage a qualified photographer to take construction photographs.

B. General: Take photographs with maximum depth of field and in focus.

1. Maintain key plan with each set of construction photographs that identifies each photographic location.

C. Concealed Work Photographs: Before proceeding with installing work that will conceal other work, take photographs sufficient in number, with annotated descriptions, to record nature and location of concealed Work, including, but not limited to, the following:

1. Underground utilities.
2. Underslab services.
3. Piping.
4. Electrical conduit.
5. Waterproofing and weather-resistant barriers.

D. Periodic Construction Photographs: Take 20 photographs coinciding with the cutoff date associated with each Application for Payment. Select vantage points to show status of construction and progress since last photographs were taken.

E. Final Completion Construction Photographs: Take 20 photographs after date of Substantial Completion for submission as Project Record Documents. Architect will inform photographer of desired vantage points.

F. Additional Photographs: Architect may request photographs in addition to periodic photographs specified. Additional photographs will be paid for by Change Order and are not included in the Contract Sum.

1. Three days' notice will be given, where feasible.
2. In emergency situations, take additional photographs within 24 hours of request.
3. Circumstances that could require additional photographs include, but are not limited to, the following:

a. Special events planned at Project site.
b. Immediate follow-up when on-site events result in construction damage or losses.
c. Photographs are to be taken at fabrication locations away from Project site. These photographs are not subject to unit prices or unit-cost allowances.
d. Substantial Completion of a major phase or component of the Work.
e. Extra record photographs at time of final acceptance.
f. Owner's request for special publicity photographs.

1.6 CONSTRUCTION VIDEO RECORDINGS

A. Video Recording Photographer: Engage a qualified videographer to record construction video recordings.

B. Preconstruction Video Recording: Before starting construction, record video recording of Project site and surrounding properties from different vantage points, as directed by Architect.

1. Flag construction limits before recording construction video recordings.
2. Show existing conditions adjacent to Project site before starting the Work.
3. Show existing buildings either on or adjoining Project site to accurately record physical conditions at the start of construction.
4. Show protection efforts by Contractor.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013233

SECTION 013300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Submittal schedule requirements.
2. Administrative and procedural requirements for submittals.

B. Related Requirements:

1. Section 012900 "Payment Procedures" for submitting Applications for Payment and the schedule of values.
2. Section 013100 "Project Management and Coordination" for submitting coordination drawings and subcontract list and for requirements for web-based Project software.
3. Section 013200 "Construction Progress Documentation" for submitting schedules and reports, including Contractor's construction schedule.
4. Section 013233 "Photographic Documentation" for submitting preconstruction photographs, periodic construction photographs, and Final Completion construction photographs.
5. Section 014000 "Quality Requirements" for submitting test and inspection reports, and schedule of tests and inspections.
6. Section 017700 "Closeout Procedures" for submitting closeout submittals and maintenance material submittals.
7. Section 017823 "Operation and Maintenance Data" for submitting operation and maintenance manuals.
8. Section 017839 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
9. Section 017900 "Demonstration and Training" for submitting video recordings of demonstration of equipment and training of Owner's personnel.

1.2 DEFINITIONS

A. Action Submittals: Written and graphic information and physical samples that require Architect's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."

B. Informational Submittals: Written and graphic information and physical samples that do not require Architect's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."

C. Portable Document Format (PDF): An open standard file format licensed by Adobe Systems used for representing documents in a device-independent and display resolution-independent fixed-layout document format.

1.3 SUBMITTAL SCHEDULE

A. Submittal Schedule: Submit, as an action submittal, a list of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Architect and additional time for handling and reviewing submittals required by those corrections.

1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
2. Initial Submittal Schedule: Submit concurrently with startup construction schedule. Include submittals required during the first 60 days of construction. List those submittals required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.
3. Final Submittal Schedule: Submit concurrently with the first complete submittal of Contractor's construction schedule.

    a. Submit revised submittal schedule as required to reflect changes in current status and timing for submittals.

4. Format: Arrange the following information in a tabular format:

    a. Scheduled date for first submittal.
    b. Specification Section number and title.
    c. Submittal Category: Action; informational.
    d. Name of subcontractor.
    e. Description of the Work covered.
    f. Scheduled date for Architect's final release or approval.
    g. Scheduled dates for purchasing.
    h. Scheduled date of fabrication.
    i. Scheduled dates for installation.

1.4 SUBMITTAL FORMATS

A. Submittal Information: Include the following information in each submittal:

1. Project name.
2. Date.
3. Name of Architect.
4. Name of Construction Manager.
5. Name of Contractor.
6. Name of firm or entity that prepared submittal.
7. Names of subcontractor, manufacturer, and supplier.

8. Unique submittal number, including revision identifier. Include Specification Section number with sequential alphanumeric identifier and alphanumeric suffix for resubmittals.

    a. Submittal Number.: Number each submittal using the Specification section number followed by a number designating the submittal order (i.e. Submittal No. 033000-01 would designate the first submittal for Section 033000; 033000-02 would designate the second. This would continue as long as necessary).

        1) For resubmittals use the original Submittal Number followed by a new sequence number (i.e. 033000-01-01 for first resubmittal of Submittal 033000-01; 033000-01-02 for second resubmittal and so on until transmittal is approved).

9. Category and type of submittal.
10. Submittal purpose and description.
11. Number and title of Specification Section, with paragraph number and generic name for each of multiple items.
12. Drawing number and detail references, as appropriate.
13. Indication of full or partial submittal.
14. Location(s) where product is to be installed, as appropriate.
15. Other necessary identification.
16. Remarks.
17. Signature of transmitter.

B. Options: Identify options requiring selection by Architect.

C. Deviations and Additional Information: On each submittal, clearly indicate deviations from requirements in the Contract Documents, including minor variations and limitations; include relevant additional information and revisions, other than those requested by Architect on previous submittals. Indicate by highlighting on each submittal or noting on attached separate sheet.

D. Paper Submittals:

1. Place a permanent label or title block on each submittal item for identification; include name of firm or entity that prepared submittal.
2. Provide a space approximately 6 by 8 inches on label or beside title block to record Contractor's review and approval markings and action taken by Architect.
3. Action Submittals: Submit three paper copies of each submittal unless otherwise indicated. Architect, through Construction Manager, will return two copies.
4. Informational Submittals: Submit two paper copies of each submittal unless otherwise indicated. Architect and Construction Manager will not return copies.
5. Additional Copies: Unless additional copies are required for final submittal, and unless Architect observes noncompliance with provisions in the Contract Documents, initial submittal may serve as final submittal.
6. Transmittal for Submittals: Assemble each submittal individually and appropriately for transmittal and handling. Transmit each submittal using transmittal form either Web-Based Project Site or Contractor generated.

E. Submittals Utilizing Web-Based Project Software: Prepare submittals as PDF files or other format indicated by Project management software.

1. All submittals shall be entered into Web-Based Project Site regardless whether paper or electronic.

1.5 SUBMITTAL PROCEDURES

A. Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.

1. Submit all action submittal items required for each Specification Section in ONE SUBMITTAL concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule. Piecemeal Submittals will be rejected until received as a complete Submittal per Specification Section.
2. Web-Based Project Management Software: Prepare submittals in PDF form, and upload to web-based Project management software website. Enter required data in web-based software site to fully identify submittal.
3. Paper: Prepare submittals in paper form and deliver to Architect.

B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.

1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
4. Coordinate transmittal of submittals for related parts of the Work specified in different Sections, so processing will not be delayed because of need to review submittals concurrently for coordination.

a. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.

1. Initial Review: Allow 15 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
3. Resubmittal Review: Allow 15 days for review of each resubmittal.

D. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.

1. Note date and content of previous submittal.
2. Note date and content of revision in label or title block, and clearly indicate extent of revision.
3. Resubmit submittals until they are marked with approval notation from Architect's action stamp.

E. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.

F. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Architect's action stamp.

1.6 SUBMITTAL REQUIREMENTS

A. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.

1. If information must be specially prepared for submittal because standard published data are unsuitable for use, submit as Shop Drawings, not as Product Data.
2. Mark each copy of each submittal to show which products and options are applicable.
3. Include the following information, as applicable:

    a. Manufacturer's catalog cuts.
    b. Manufacturer's product specifications.
    c. Standard color charts.
    d. Statement of compliance with specified referenced standards.
    e. Testing by recognized testing agency.
    f. Application of testing agency labels and seals.
    g. Notation of coordination requirements.
    h. Availability and delivery time information.

4. For equipment, include the following in addition to the above, as applicable:

    a. Wiring diagrams that show factory-installed wiring.
    b. Printed performance curves.
    c. Operational range diagrams.
    d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.

5. Submit Product Data and Shop Drawings at same time, and concurrently with Samples.

B. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data unless submittal based on Architect's digital data drawing files is otherwise permitted.

1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:

a. Identification of products.
b. Schedules.
c. Compliance with specified standards.
d. Notation of coordination requirements.
e. Notation of dimensions established by field measurement.
f. Relationship and attachment to adjoining construction clearly indicated.
g. Seal and signature of professional engineer if specified.

2. Paper Sheet Size: Except for templates, patterns, and similar full-size Drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches, but no larger than 30 by 42 inches.

C. Samples: Submit Samples for review of type, color, pattern, and texture for a check of these characteristics with other materials.

1. Transmit Samples that contain multiple, related components, such as accessories together in one submittal package.
2. Identification: Permanently attach label on unexposed side of Samples that includes the following:

a. Project name and submittal number.
b. Generic description of Sample.
c. Product name and name of manufacturer.
d. Sample source.
e. Number and title of applicable Specification Section.
f. Specification paragraph number and generic name of each item.

3. Web-Based Project Management Software: Prepare submittals in PDF form from digital images or photographs, and upload to web-based Project software website. Enter required data in web-based software site to fully identify submittal.

a. Where no digital image file exists from the manufacturer, Contractor shall take digital photographs of samples and post submittal to the Project Web Site.

4. Paper Transmittal: Include paper transmittal, including complete submittal information indicated for each physical sample to be delivered to Architect.
5. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.

a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.

6. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units, showing the full range of colors, textures, and patterns available.

a. Number of Samples: Submit two full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from

manufacturer's product line. Architect will return one submittal with options selected.

7. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.

    a. Number of Samples: Submit three sets of Samples. Architect will retain one Sample sets; remainder will be returned. Mark up and retain one returned Sample set as a project record Sample.

        1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
        2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.

D. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.

E. Design Data: Prepare and submit written and graphic information indicating compliance with indicated performance and design criteria in individual Specification Sections. Include list of assumptions and summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Number each page of submittal.

F. Certificates:

1. Certificates and Certifications Submittals: Submit a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity. Provide a notarized signature where indicated.
2. Installer Certificates: Submit written statements on manufacturer's letterhead, certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
3. Manufacturer Certificates: Submit written statements on manufacturer's letterhead, certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
4. Material Certificates: Submit written statements on manufacturer's letterhead, certifying that material complies with requirements in the Contract Documents.
5. Product Certificates: Submit written statements on manufacturer's letterhead, certifying that product complies with requirements in the Contract Documents.

6. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of AWS B2.1/B2.1M on AWS forms. Include names of firms and personnel certified.

G. Test and Research Reports:

1. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for substrate preparation and primers required.
2. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
3. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
4. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
5. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
6. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:

a. Name of evaluation organization.
b. Date of evaluation.
c. Time period when report is in effect.
d. Product and manufacturers' names.
e. Description of product.
f. Test procedures and results.
g. Limitations of use.

1.7 DELEGATED DESIGN SERVICES

A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.

1. If criteria indicated are insufficient to perform services or certification required, submit a written request for additional information to Architect.

B. Delegated Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF file paper copies of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.

1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

1.8 CONTRACTOR'S REVIEW

A. Action Submittals and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.

1. Submittal Markup and Comment Colors: Contractor shall use green or other differing color from Architect’s color. Architect shall use red color for markups and comments. CONTRACTOR SHALL NOT USE RED FOR MARKUPS.

B. Contractor's Approval: Indicate Contractor's approval for each submittal with a uniform approval stamp. Include name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

1. Architect will not review submittals received from Contractor that do not have Contractor's review and approval. Submittal will be returned without action.

1.9 ARCHITECT'S REVIEW

A. Action Submittals: Architect will review each submittal, indicate corrections or revisions required, and return.

1. PDF Submittals: Architect will indicate, via markup on each submittal, the appropriate action, as follows:

a. Reviewed: Where submittals are marked “Reviewed,” that part of the Work covered by the submittal may proceed provided it complies with requirements of the Contract Documents; final acceptance will depend upon that compliance.
b. Reviewed – Additional Information Required: Where submittals are marked “Reviewed – Additional Information Required,” the information submitted has been reviewed and approved as noted. However, additional information as noted and/or required by Contract Documents needs to be submitted.
c. Furnish as Corrected: When submittals are marked “Furnish as Corrected,” that part of the Work covered by the submittal may proceed provided it complies with notations or corrections on the submittal and requirements of the Contract Documents; final acceptance will depend on that compliance.
d. Revise and Resubmit: When submittal is marked “Revise and Resubmit,” do not proceed with that part of the Work covered by the submittal, including purchasing, fabrication, delivery or other activity. Revise or prepare a new submittal in accordance with the notations; resubmit without delay. Repeat if necessary to obtain a different action mark.

e. Do not permit submittals marked “Revise and Resubmit” to be used at the Project site, or elsewhere where Work is in progress.
f. Rejected: When submittal is marked “Rejected,” information submitted is not in compliance with Contract Documents. Resubmit submittal as required by Contract Documents.
g. Not Reviewed: When submittal is marked “Not Reviewed,” submittal is incomplete without sufficient information to review as identified above, submittal is not required by Construction Documents, or is not specific to Project.

B. Informational Submittals: Architect will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.

C. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect.

D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.

E. Architect will return without review submittals received from sources other than Contractor.

F. Submittals not required by the Contract Documents will be returned by Architect without action.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013300

SECTION 014000 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for quality assurance and quality control.

B. Testing and inspection services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.

1. Specific quality-assurance and quality-control requirements for individual work results are specified in their respective Specification Sections. Requirements in individual Sections may also cover production of standard products.
2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and quality-control procedures that facilitate compliance with the Contract Document requirements.
3. Requirements for Contractor to provide quality-assurance and quality-control services required by Architect, Owner, Commissioning Authority, Construction Manager, or authorities having jurisdiction are not limited by provisions of this Section.

1.3 DEFINITIONS

A. Experienced: When used with an entity or individual, "experienced," unless otherwise further described, means having successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction. Refer to individual specification sections for experience requirements.

B. Field Quality-Control Tests and Inspections: Tests and inspections that are performed on-site for installation of the Work and for completed Work.

C. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, subcontractor, or sub-subcontractor, to perform a particular construction operation, including installation, erection, application, assembly, and similar operations.

1. Use of trade-specific terminology in referring to a Work result does not require that certain construction activities specified apply exclusively to specific trade(s).

D. Mockups: Physical assemblies of portions of the Work constructed to establish the standard by which the Work will be judged. Mockups are not Samples.

1. Mockups are used for one or more of the following:

a. Verify selections made under Sample submittals.
b. Demonstrate aesthetic effects.
c. Demonstrate the qualities of products and workmanship.
d. Demonstrate successful installation of interfaces between components and systems.
e. Perform preconstruction testing to determine system performance.

2. Product Mockups: Mockups that may include multiple products, materials, or systems specified in a single Section.
3. In-Place Mockups: Mockups constructed on-site in their actual final location as part of permanent construction.

E. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria. Unless otherwise indicated, copies of reports of tests or inspections performed for other than the Project do not meet this definition.

F. Product Tests: Tests and inspections that are performed by a nationally recognized testing laboratory (NRTL) according to 29 CFR 1910.7, by a testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program (NVLAP), or by a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.

G. Source Quality-Control Tests and Inspections: Tests and inspections that are performed at the source (e.g., plant, mill, factory, or shop).

H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. The term "testing laboratory" has the same meaning as the term "testing agency."

I. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work, to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.

J. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work, to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Contractor's quality-control services do not include contract administration activities performed by Architect or Construction Manager.

1.4 DELEGATED DESIGN SERVICES

A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.

1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.

B. Delegated Design Services Statement: Submit a statement signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional, indicating that the products and systems are in compliance with performance and design criteria indicated. Include list of codes, loads, and other factors used in performing these services.

1.5 CONFLICTING REQUIREMENTS

A. Conflicting Standards and Other Requirements: If compliance with two or more standards or requirements is specified and the standards or requirements establish different or conflicting requirements for minimum quantities or quality levels, inform the Architect regarding the conflict and obtain clarification prior to proceeding with the Work. Refer conflicting requirements that are different, but apparently equal, to Architect for clarification before proceeding.

B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified is the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

1.6 INFORMATIONAL SUBMITTALS

A. Contractor's Quality-Control Plan: For quality-assurance and quality-control activities and responsibilities.

B. Qualification Data: For Contractor's quality-control personnel.

C. Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility submitted to authorities having jurisdiction before starting work on the following systems:

1. Seismic-force-resisting system, designated seismic system, or component listed in the Statement of Special Inspections.
2. Primary wind-force-resisting system or a wind-resisting component listed in the Statement of Special Inspections.

D. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.

E. Schedule of Tests and Inspections: Prepare in tabular form and include the following:

1. Specification Section number and title.

2. Entity responsible for performing tests and inspections.
3. Description of test and inspection.
4. Identification of applicable standards.
5. Identification of test and inspection methods.
6. Number of tests and inspections required.
7. Time schedule or time span for tests and inspections.
8. Requirements for obtaining samples.
9. Unique characteristics of each quality-control service.

F. Reports: Prepare and submit certified written reports and documents as specified.

G. Permits, Licenses, and Certificates: For Owner's record, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents established for compliance with standards and regulations bearing on performance of the Work.

1.7 CONTRACTOR'S QUALITY-CONTROL PLAN

A. Quality-Control Plan, General: Submit quality-control plan within 10 days of Notice of Award, and not less than five days prior to preconstruction conference. Submit in format acceptable to Architect. Identify personnel, procedures, controls, instructions, tests, records, and forms to be used to carry out Contractor's quality-assurance and quality-control responsibilities and to coordinate Owner's quality-assurance and quality-control activities. Coordinate with Contractor's Construction Schedule.

B. Quality-Control Personnel Qualifications: Engage qualified personnel trained and experienced in managing and executing quality-assurance and quality-control procedures similar in nature and extent to those required for Project.

1. Project quality-control manager does not have other Project responsibilities.

C. Submittal Procedure: Describe procedures for ensuring compliance with requirements through review and management of submittal process. Indicate qualifications of personnel responsible for submittal review.

D. Testing and Inspection: In quality-control plan, include a comprehensive schedule of Work requiring testing or inspection, including the following:

1. Contractor-performed tests and inspections, including subcontractor-performed tests and inspections. Include required tests and inspections and Contractor-elected tests and inspections. Distinguish source quality-control tests and inspections from field quality-control tests and inspections.
2. Special inspections required by authorities having jurisdiction and indicated on the Statement of Special Inspections.
3. Owner-performed tests and inspections indicated in the Contract Documents.

E. Continuous Inspection of Workmanship: Describe process for continuous inspection during construction to identify and correct deficiencies in workmanship in addition to testing and inspection specified. Indicate types of corrective actions to be required to bring the Work into

compliance with standards of workmanship established by Contract requirements and approved mockups.

F. Monitoring and Documentation: Maintain testing and inspection reports, including log of approved and rejected results. Include Work Architect has indicated as nonconforming or defective. Indicate corrective actions taken to bring nonconforming Work into compliance with requirements. Comply with requirements of authorities having jurisdiction.

1.8 REPORTS AND DOCUMENTS

A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:

1. Date of issue.
2. Project title and number.
3. Name, address, telephone number, and email address of testing agency.
4. Dates and locations of samples and tests or inspections.
5. Names of individuals making tests and inspections.
6. Description of the Work and test and inspection method.
7. Identification of product and Specification Section.
8. Complete test or inspection data.
9. Test and inspection results and an interpretation of test results.
10. Record of temperature and weather conditions at time of sample-taking and testing and inspection.
11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
12. Name and signature of laboratory inspector.
13. Recommendations on retesting and reinspecting.

B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:

1. Name, address, telephone number, and email address of technical representative making report.
2. Statement on condition of substrates and their acceptability for installation of product.
3. Statement that products at Project site comply with requirements.
4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
6. Statement of whether conditions, products, and installation will affect warranty.
7. Other required items indicated in individual Specification Sections.

C. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:

1. Name, address, telephone number, and email address of factory-authorized service representative making report.
2. Statement that equipment complies with requirements.
3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
4. Statement of whether conditions, products, and installation will affect warranty.
5. Other required items indicated in individual Specification Sections.

1.9 QUALITY ASSURANCE

A. Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.

B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units. As applicable, procure products from manufacturers able to meet qualification requirements, warranty requirements, and technical or factory-authorized service representative requirements.

C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

D. Installer Qualifications: A firm or individual experienced in installing, erecting, applying, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.

E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that is similar in material, design, and extent to those indicated for this Project.

F. Specialists: Certain Specification Sections require that specific construction activities be performed by entities who are recognized experts in those operations. Specialists will satisfy qualification requirements indicated and engage in the activities indicated.

1. Requirements of authorities having jurisdiction supersede requirements for specialists.

G. Testing and Inspecting Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspection indicated, as documented in accordance with ASTM E329, and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.

H. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

I. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect, demonstrate, repair, and perform service on installations of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

J. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following Contractor's responsibilities, including the following:

1. Provide test specimens representative of proposed products and construction.
2. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
3. Provide sizes and configurations of test assemblies, mockups, and laboratory mockups to adequately demonstrate capability of products to comply with performance requirements.
4. Build site-assembled test assemblies and mockups, using installers who will perform same tasks for Project.
5. When testing is complete, remove test specimens and test assemblies, and mockups; do not reuse products on Project.
6. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect, through Construction Manager, with copy to Contractor. Interpret tests and inspections, and state in each report whether tested and inspected Work complies with or deviates from the Contract Documents.

K. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:

1. Build mockups of size indicated.
2. Build mockups in location indicated or, if not indicated, as directed by Architect or Construction Manager.
3. Notify Architect and Construction Manager seven days in advance of dates and times when mockups will be constructed.
4. Employ supervisory personnel who will oversee mockup construction. Employ workers who will be employed to perform same tasks during the construction at Project.
5. Demonstrate the proposed range of aesthetic effects and workmanship.
6. Obtain Architect's approval of mockups before starting corresponding Work, fabrication, or construction.

    a. Allow seven days for initial review and each re-review of each mockup.

7. Promptly correct unsatisfactory conditions noted by Architect's preliminary review, to the satisfaction of the Architect, before completion of final mockup.
8. Approval of mockups by the Architect does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
9. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
10. Demolish and remove mockups when directed unless otherwise indicated.

1.10 QUALITY CONTROL

A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage and pay for a qualified testing agency to perform these services.

1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspection they are engaged to perform.
2. Costs for retesting and reinspecting construction that replaces or is necessitated by Work that failed to comply with the Contract Documents will be charged to Contractor, and the Contract Sum will be adjusted by Change Order.

B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities, whether specified or not, to verify and document that the Work complies with requirements.

1. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
2. Engage a qualified testing agency to perform quality-control services.

    a. Contractor will not employ same entity engaged by Owner, unless agreed to in writing by Owner.

3. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspection will be performed.
4. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
5. Testing and inspection requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.

C. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.

D. Testing Agency Responsibilities: Cooperate with Architect, Commissioning Authority and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.

1. Notify Architect, Commissioning Authority, and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
2. Determine the locations from which test samples will be taken and in which in-situ tests are conducted.
3. Conduct and interpret tests and inspections, and state in each report whether tested and inspected Work complies with or deviates from requirements.
4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.

5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
6. Do not perform duties of Contractor.

E. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Section 013300 "Submittal Procedures."

F. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.

G. Contractor's Associated Requirements and Services: Cooperate with agencies and representatives performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:

1. Access to the Work.
2. Incidental labor and facilities necessary to facilitate tests and inspections.
3. Adequate quantities of representative samples of materials that require testing and inspection. Assist agency in obtaining samples.
4. Facilities for storage and field curing of test samples.
5. Preliminary design mix proposed for use for material mixes that require control by testing agency.
6. Security and protection for samples and for testing and inspection equipment at Project site.

H. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and quality-control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspection.

1. Schedule times for tests, inspections, obtaining samples, and similar activities.

I. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents as a component of Contractor's quality-control plan. Coordinate and submit concurrently with Contractor's Construction Schedule. Update and submit with each Application for Payment.

1. Schedule Contents: Include tests, inspections, and quality-control services, including Contractor- and Owner-retained services, commissioning activities, and other Project-required services paid for by other entities.
2. Distribution: Distribute schedule to Owner, Architect, Commissioning Authority, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

1.11 SPECIAL TESTS AND INSPECTIONS

A. Special Tests and Inspections: Owner will engage and pay for a qualified testing agency to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner, and as follows:

1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures, and reviewing the completeness and adequacy of those procedures to perform the Work.
2. Notifying Architect, Commissioning Authority, and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
3. Submitting a certified written report of each test, inspection, and similar quality-control service to Architect and Commissioning Authority with copy to Contractor and to authorities having jurisdiction.
4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
5. Interpreting tests and inspections, and stating in each report whether tested and inspected Work complies with or deviates from the Contract Documents.
6. Retesting and reinspecting corrected Work.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 ACCEPTABLE TESTING AGENCIES

A. Testing Agency for special inspections and material tests to be determined by the Owner.

B. Geotechnical firm for soils inspection and testing shall be:

1. CMT Technical Services
9980 W. Sam Houston Pkwy S., Suite 500
Houston, Texas 77099
Phone: (713)-686-6999

C. Texas Pollutant Discharge Elimination System (TPDES) inspection agency to be determined by the Owner.

3.2 TEST AND INSPECTION LOG

A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:

1. Date test or inspection was conducted.
2. Description of the Work tested or inspected.
3. Date test or inspection results were transmitted to Architect.
4. Identification of testing agency or special inspector conducting test or inspection.

B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Architect's, Commissioning Authority's, and authorities' having jurisdiction reference during normal working hours.

1. Submit log at Project closeout as part of Project Record Documents.

3.3 REPAIR AND PROTECTION

A. General: On completion of testing, inspection, sample-taking, and similar services, repair damaged construction and restore substrates and finishes.

1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 017300 "Execution."

B. Protect construction exposed by or for quality-control service activities.

C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 014000

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SECTION 014200 - REFERENCES

PART 1 - GENERAL

1.1 DEFINITIONS

A. General: Basic Contract definitions are included in the Conditions of the Contract.

B. "Approved": When used to convey Architect's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.

C. "Directed": A command or instruction by Architect. Other terms including "requested," "authorized," "selected," "required," and "permitted" have the same meaning as "directed."

D. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."

E. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.

F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.

G. "Install": Unload, temporarily store, unpack, assemble, erect, place, anchor, apply, work to dimension, finish, cure, protect, clean, and similar operations at Project site.

H. "Provide": Furnish and install, complete and ready for the intended use.

I. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

1.2 INDUSTRY STANDARDS

A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.

B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.

1. For standards referenced by applicable building codes, comply with dates of standards as listed in building codes.

C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.

1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

1.3 ABBREVIATIONS AND ACRONYMS

A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities indicated in Gale's "Encyclopedia of Associations: National Organizations of the U.S." or in Columbia Books' "National Trade & Professional Associations of the United States."

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 014200

SECTION 014339 - MOCKUPS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Integrated exterior mockups.

B. Related Requirements:

1. Section 014000 "Quality Requirements" for quality assurance requirements for aesthetic and workmanship mockups specified in other Sections.

1.2 DEFINITIONS

A. Integrated Exterior Mockups: Mockups of the exterior envelope constructed on-site as freestanding temporary built elements, consisting of multiple products, assemblies, and subassemblies.

1.3 QUALITY ASSURANCE

A. Build mockups to do the following:

1. Verify selections made under Sample submittals.
2. Demonstrate aesthetic effects.
3. Demonstrate the qualities of products and workmanship.
4. Demonstrate acceptable coordination between components and systems.

B. Fabrication: Before fabricating or installing portions of the Work requiring mockups, build mockups for each form of construction and finish required. Use materials and installation methods as required for the Work.

1. Build mockups of size indicated.
2. Build mockups in location indicated or, if not indicated, as directed by Architect or Construction Manager.
3. Employ supervisory personnel who will oversee mockup construction. Employ workers who will be employed to perform same tasks during the construction at Project.
4. Demonstrate the proposed range of aesthetic effects and workmanship.
5. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
6. Demolish and remove mockups when directed unless otherwise indicated.

C. Notifications:

1. Notify Architect seven days in advance of the dates and times when mockups will be constructed.
2. Allow seven days for initial review and each re-review of each mockup.

D. Approval: Obtain Architect's approval of mockups before starting fabrication or construction of corresponding Work.

1. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.4 COORDINATION

A. Coordinate schedule for construction of mockups, so construction, testing, and review of mockups do not impact Project schedule.

PART 2 - PRODUCTS

2.1 INTEGRATED EXTERIOR MOCKUPS

A. Construct integrated exterior mockups as indicated on Drawings. Construct mockups to demonstrate constructability, coordination of trades, and sequencing of Work; and to ensure materials, components, subassemblies, assemblies, and interfaces integrate into a system complying with indicated performance and aesthetic requirements.

B. Build integrated exterior mockups using installers and construction methods that will be used in completed construction.

C. Use specified products that have been approved by Architect. Coordinate installation of materials and products specified in individual Specification Sections that include Work included in integrated exterior mockups.

D. The Work of integrated exterior mockups includes, but is not limited to, the following:

1. Masonry veneer.
2. Stone trim.
3. Air and weather barriers.
4. Thermal insulation.
5. Through-wall flashing.
6. Flashing and sheet metal trim.
7. Joint sealants.
8. .

E. Photographic Documentation: Document construction of integrated exterior mockups with photographs in accordance with Section 013233 "Photographic Documentation." Provide photographs showing details of interface of different materials and assemblies.

F. Provide and document modifications to construction details and interfaces between components and systems required to properly sequence the Work, or to pass performance testing requirements. Obtain Architect's approval for modifications.

G. Retain approved mockups constructed in place. Incorporate fully into the Work.

PART 3 - EXECUTION (Not Used)

END OF SECTION 014339

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SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.

B. Related Requirements:

1. Section 011000 "Summary" for work restrictions and limitations on utility interruptions.

1.3 USE CHARGES

A. Installation, removal, and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities engaged in the Project to use temporary services and facilities without cost, including, but not limited to, Owner's construction forces, Architect, occupants of Project, testing agencies, and authorities having jurisdiction.

B. Sewer Service: Pay sewer-service use charges for sewer usage by all entities for construction operations.

C. Water Service: Pay water-service use charges for water used by all entities for construction operations.

D. Electric Power Service: Pay electric-power-service use charges for electricity used by all entities for construction operations.

1.4 INFORMATIONAL SUBMITTALS

A. Fire-Safety Program: Show compliance with requirements of NFPA 241 and authorities having jurisdiction. Indicate Contractor personnel responsible for management of fire-prevention program.

B. Moisture- and Mold-Protection Plan: Describe procedures and controls for protecting materials and construction from water absorption and damage and mold. Describe delivery, handling, storage, installation, and protection provisions for materials subject to water absorption or water damage.

1. Indicate procedures for discarding water-damaged materials, protocols for mitigating water intrusion into completed Work, and requirements for replacing water-damaged Work.
2. Indicate sequencing of work that requires water, such as sprayed fire-resistive materials, plastering, and terrazzo grinding, and describe plans for dealing with water from these operations. Show procedures for verifying that wet construction has dried sufficiently to permit installation of finish materials.
3. Indicate methods to be used to avoid trapping water in finished work.

C. Dust- and HVAC-Control Plan: Submit coordination drawing and narrative that indicates the dust- and HVAC-control measures proposed for use, proposed locations, and proposed time frame for their operation. Include the following:

1. Locations of dust-control partitions at each phase of work.
2. HVAC system isolation schematic drawing.
3. Location of proposed air-filtration system discharge.
4. Waste-handling procedures.
5. Other dust-control measures.

D. Noise and Vibration Control Plan: Identify construction activities that may impact the occupancy and use of existing spaces within the building or adjacent existing buildings, whether occupied by others, or occupied by the Owner. Include the following:

1. Methods used to meet the goals and requirements of the Owner.
2. Concrete cutting method(s) to be used.
3. Location of construction devices on the site.
4. Show compliance with the use and maintenance of quieted construction devices for the duration of the Project.
5. Indicate activities that may disturb building occupants and that are planned to be performed during non-standard working hours as coordinated with the Owner.

1.5 QUALITY ASSURANCE

A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.

B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

C. Accessible Temporary Egress: Comply with applicable provisions in the United States Access Board's ADA-ABA Accessibility Guidelines, ICC/ANSI A117.1 and Texas Accessibility Standards.

1.6 PROJECT CONDITIONS

A. Temporary Use of Permanent Facilities: Engage Installer of each permanent service to assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

B. Permanent Heating System: The Contractor may make arrangements with the Mechanical Subcontractor to use the permanent heating system to provide heat, as required during construction, after the installation of the system is sufficiently complete and its use approved by the Mechanical Subcontractor, the Architect-Engineer and the Owner. Costs for fuel, filter replacement, and cleaning at the termination of the heating period shall be borne by the General Contractor. If approved, the use of the permanent heating system prior to Substantial Completion shall not reduce the one year warranty period scheduled to start at Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Chain-Link Fencing: Minimum 2-inch, 0.148-inch- thick, galvanized-steel, chain-link fabric fencing; minimum 6 feet high with galvanized-steel pipe posts; minimum 2-3/8-inch- OD line posts and 2-7/8-inch- OD corner and pull posts, with 1-5/8-inch- OD top rails.

B. Fencing Windscreen Privacy Screen: Polyester fabric scrim with grommets for attachment to chain-link fence, sized to height of fence, in color selected by Architect from manufacturer's standard colors.

C. Polyethylene Sheet: Reinforced, fire-resistive sheet, 10-mil minimum thickness, with flame-spread rating of 15 or less in accordance with ASTM E84 and passing NFPA 701 Test Method 2.

D. Dust-Control Adhesive-Surface Walk-Off Mats: Provide mats, minimum 36 by 60 inches.

E. Insulation: Unfaced mineral-fiber blanket, manufactured from glass, slag wool, or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively.

2.2 TEMPORARY FACILITIES

A. Field Offices: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.

B. Common-Use Field Office: Of sufficient size to accommodate needs of Owner, Architect, and construction personnel office activities and to accommodate Project meetings specified in other Division 01 Sections. Keep office clean and orderly. Furnish and equip offices as follows:

1. Furniture required for Project-site documents, including file cabinets, plan tables, plan racks, and bookcases.
2. Conference room of sufficient size to accommodate meetings of 10 individuals. Provide electrical power service and 120-V ac duplex receptacles, with no fewer than one receptacle on each wall. Furnish room with conference table, chairs, and 4-foot- square tack and marker boards.
3. Drinking water and private toilet.
4. Heating and cooling equipment necessary to maintain a uniform indoor temperature of 68 to 72 deg F.
5. Lighting fixtures capable of maintaining average illumination of 20 fc at desk height.

C. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.

1. Store combustible materials apart from building.

D. Temporary Toilet Units: Provide self-contained single-occupant toilet units of the chemical, aerated recirculation, or combustion type, properly vented and fully enclosed with a glass fiber reinforced polyester shell or similar non-absorbent material. Contractor shall not use Owner's toilet facilities.

2.3 EQUIPMENT

A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.

B. HVAC Equipment: Unless Owner authorizes use of permanent HVAC system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.

1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
2. Heating, Cooling, and Dehumidifying Units: Listed and labeled for type of fuel being consumed, by a qualified testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.
3. Permanent HVAC System: If Owner authorizes use of permanent HVAC system for temporary use during construction, provide filter with MERV of 8 at each return-air grille in system and remove at end of construction.

PART 3 - EXECUTION

3.1 TEMPORARY FACILITIES, GENERAL

A. Conservation: Coordinate construction and use of temporary facilities with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.

1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. See other Sections for disposition of salvaged materials that are designated as Owner's property.

3.2 INSTALLATION, GENERAL

A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.

1. Locate facilities to limit site disturbance as specified in Section 011000 "Summary."

B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

C. Isolation of Work Areas in Occupied Facilities: Prevent dust, fumes, and odors from entering occupied areas.

1. Prior to commencing work, isolate the HVAC system in area where work is to be performed.

a. Disconnect supply and return ductwork in work area from HVAC systems servicing occupied areas.
b. Maintain negative air pressure within work area, using HEPA-equipped air-filtration units, starting with commencement of temporary partition construction, and continuing until removal of temporary partitions is complete.

2. Maintain dust partitions during the Work. Use vacuum collection attachments on dust-producing equipment. Isolate limited work within occupied areas using portable dust-containment devices.
3. Perform daily construction cleanup and final cleanup using approved, HEPA-filter-equipped vacuum equipment.

3.3 TEMPORARY UTILITY INSTALLATION

A. General: Install temporary service or connect to existing service.

1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.

B. Sewers and Drainage: Provide temporary utilities to remove effluent lawfully.

1. Connect temporary sewers to municipal system or private system indicated as directed by authorities having jurisdiction.

C. Water Service: Install water service and distribution piping in sizes and pressures adequate for construction.

D. Sanitary Facilities: Provide temporary toilets, wash facilities, safety shower and eyewash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.

1. Use of Permanent Toilets: Use of Owner's existing or new toilet facilities is not permitted.

E. Temporary Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.

1. Provide temporary dehumidification systems when required to reduce ambient and substrate moisture levels to level required to allow installation or application of finishes and their proper curing or drying.

F. Electric Power Service: Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.

1. Install electric power service overhead or underground unless otherwise indicated.

G. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.

1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.

H. Telephone Service: Provide temporary telephone service in common-use facilities for use by all construction personnel. Install WiFi cell phone access equipment for each field office.

1. At each field office, post a list of important telephone numbers.

a. Police and fire departments.
b. Ambulance service.
c. Contractor's home office.
d. Contractor's emergency after-hours telephone number.
e. Architect's office.
f. Owner's office.
g. Principal subcontractors' field and home offices.

I. Electronic Communication Service: Provide secure WiFi wireless connection to internet with provisions for access by Architect and Owner.

J. Project Computer: Provide a desktop computer in the primary field office adequate for use by Architect and Owner to access Project electronic documents and maintain electronic communications. Equip computer with not less than the following:

1. Processor: Intel Core i5 or i7.
2. Memory: 16 gigabyte.

3. Disk Storage: 1 -terabyte hard-disk drive and combination DVD-RW/CD-RW drive.
4. Display: 24-inch LCD monitor with 256-Mb dedicated video RAM.
5. Full-size keyboard and mouse.
6. Network Connectivity: 10/100BaseT Ethernet.
7. Operating System: Microsoft Windows 10 Professional.
8. Productivity Software:

    a. Microsoft Office Professional, 2013 or higher, including Word, Excel, and Outlook.
    b. Bluebeam Revu.
    c. WinZip 10.0 or higher.

9. Printer: "All-in-one" unit equipped with printer server, combining color printing, photocopying, scanning, and faxing, or separate units for each of these three functions.
10. Internet Service: Broadband modem, router, and ISP, equipped with hardware firewall, providing minimum 10.0 -Mbps upload and 15 -Mbps download speeds at each computer.
11. Internet Security: Integrated software, providing software firewall, virus, spyware, phishing, and spam protection in a combined application.
12. Backup: External hard drive, minimum 2 terrabytes, with automated backup software providing daily backups.

3.4 SUPPORT FACILITIES INSTALLATION

A. Comply with the following:

1. Provide construction for temporary field offices, shops, and sheds located within construction area or within 30 feet of building lines that is noncombustible in accordance with ASTM E136. Comply with NFPA 241.
2. Maintain support facilities until Architect schedules Substantial Completion inspection. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.

B. Traffic Controls: Comply with requirements of authorities having jurisdiction.

1. Protect existing site improvements to remain, including curbs, pavement, and utilities.
2. Maintain access for fire-fighting equipment and access to fire hydrants.

C. Parking: Provide temporary parking areas for construction personnel.

D. Storage and Staging: Use designated areas of Project site for storage and staging needs.

E. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.

1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties or endanger permanent Work or temporary facilities.

F. Project Signs: Provide Project signs as indicated. Unauthorized signs are not permitted.

1. Identification Signs: Provide Project identification signs with Owner, Architect, and Contractor’s logos either painted plywood sign or printed wind screen material. Each entity shall provide their logo to Contractor for the sign fabricator.
2. Temporary Signs: Provide other signs as indicated and as required to inform public and individuals seeking entrance to Project.

    a. Provide temporary, directional signs for construction personnel and visitors.

3. Maintain and touch up signs, so they are legible at all times.

G. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Comply with progress cleaning requirements in Section 017300 "Execution."

H. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.

1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.

I. Temporary Stairs: Until permanent stairs are available, provide temporary stairs where ladders are not adequate.

J. Temporary Use of Permanent Stairs: Use of new stairs for construction traffic will be permitted, provided stairs are protected and finishes restored to new condition at time of Substantial Completion.

3.5 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.

1. Where access to adjacent properties is required in order to affect protection of existing facilities, obtain written permission from adjacent property owner to access property for that purpose.

B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.

1. Comply with work restrictions specified in Section 011000 "Summary."

C. Temporary Erosion and Sedimentation Control: Provide measures to prevent soil erosion and discharge of soil-bearing water runoff and airborne dust to undisturbed areas and to adjacent properties and walkways, according to erosion- and sedimentation-control Drawings.

1. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross tree- or plant-protection zones.
2. Inspect, repair, and maintain erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
3. Clean, repair, and restore adjoining properties and roads affected by erosion and sedimentation from Project site during the course of Project.
4. Remove erosion and sedimentation controls, and restore and stabilize areas disturbed during removal.

D. Stormwater Control: Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.

E. Tree and Plant Protection: Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from damage from construction operations. Protect tree root systems from damage, flooding, and erosion.

F. Pest Control: Engage pest-control service to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals, so Project will be free of pests and their residues at Substantial Completion. Perform control operations lawfully, using materials approved by authorities having jurisdiction.

G. Site Enclosure Fence: Before construction operations begin, furnish and install site enclosure fence in a manner that will prevent people from easily entering site except by entrance gates.

1. Extent of Fence: As required to enclose entire Project site or portion determined sufficient to accommodate construction operations.
2. Maintain security by limiting number of keys and restricting distribution to authorized personnel.

H. Security Enclosure and Lockup: Install temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Lock entrances at end of each workday.

I. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.

J. Temporary Egress: Provide temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction. Provide signage directing occupants to temporary egress.

K. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.

1. Where heating or cooling is needed and permanent enclosure is incomplete, insulate temporary enclosures.

L. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241; manage fire-prevention program and NFPA 10 “Standard for Portable Fire Extinguishers.”

1. Prohibit smoking in construction areas. Comply with additional limits on smoking specified in other Sections.
2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition in accordance with requirements of authorities having jurisdiction.
3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.
4. Locate fire extinguishers where convenient and effective for their intended purpose, but not less than one extinguisher on each floor at or near each usable stairwell.
5. Existing fire sprinkler and fire detection systems shall remain operational at all times, unless authorized shut-downs are approved by the Architect, Owner, and Authority Having Jurisdiction.
6. Tie-in to new fire protection systems shall be scheduled for non-occupied hours.

3.6 MOISTURE AND MOLD CONTROL

A. Moisture and Mold Protection: Protect stored materials and installed Work in accordance with Moisture and Mold Protection Plan.

B. Exposed Construction Period: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect as follows:

1. Protect porous materials from water damage.
2. Protect stored and installed material from flowing or standing water.
3. Keep porous and organic materials from coming into prolonged contact with concrete.
4. Remove standing water from decks.
5. Keep deck openings covered or dammed.

C. Partially Enclosed Construction Period: After installation of weather barriers but before full enclosure and conditioning of building, when installed materials are still subject to infiltration of moisture and ambient mold spores, protect as follows:

1. Do not load or install drywall or other porous materials or components, or items with high organic content, into partially enclosed building.
2. Keep interior spaces reasonably clean and protected from water damage.
3. Periodically collect and remove waste containing cellulose or other organic matter.
4. Discard or replace water-damaged material.
5. Do not install material that is wet.
6. Discard and replace stored or installed material that begins to grow mold.
7. Perform work in a sequence that allows wet materials adequate time to dry before enclosing the material in gypsum board or other interior finishes.

D. Controlled Construction Period: After completing and sealing of the building enclosure but prior to the full operation of permanent HVAC systems, maintain as follows:

1. Control moisture and humidity inside building by maintaining effective dry-in conditions.
2. Use temporary or permanent HVAC system to control humidity within ranges specified for installed and stored materials.
3. Comply with manufacturer's written instructions for temperature, relative humidity, and exposure to water limits.

    a. Hygroscopic materials that may support mold growth, including wood and gypsum-based products, that become wet during the course of construction and remain wet for 48 hours are considered defective and require replacing.
    b. Measure moisture content of materials that have been exposed to moisture during construction operations or after installation. Record readings beginning at time of exposure and continuing daily for 48 hours. Identify materials containing moisture levels higher than allowed. Report findings in writing to Architect.
    c. Remove and replace materials that cannot be completely restored to their manufactured moisture level within 48 hours.

3.7 OPERATION, TERMINATION, AND REMOVAL

A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.

B. Maintenance: Maintain facilities in good operating condition until removal.

1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.

C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.

D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.

1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
2. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 017700 "Closeout Procedures."

END OF SECTION 015000

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SECTION 015639 - TEMPORARY TREE AND PLANT 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. Tree Preservation work includes, but is not limited to:

1. Protection of existing trees and all other items indicated to remain in place.
2. Maintenance of protected areas.
3. Clearing and grubbing activity within protected areas.
4. Damage compensation.

1.3 APPLICABLE REGULATIONS

A. Comply with all applicable local laws and regulations concerning tree preservation as well as the specific requirements stated elsewhere in the Specifications.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 PROTECTION OF EXISTING TREES TO REMAIN

A. Tagging and Fencing:

1. Trees to remain shall be tagged and protective fencing installed prior to any construction, demolition, or other disturbance.
2. Protective fencing shall be installed at the dripline of the tree to be protected unless otherwise noted on the Plans.
3. The area inside the protective fencing will heretofore be referred to as the protected area.
4. The Contractor shall verify tagged trees and fence locations in field with the Landscape Architect prior to any construction or demolition activity.

3.2 MAINTENANCE OF PROTECTED AREA

A. No construction activity shall occur inside protected areas other than that landscape construction which is required for completion of the project.

1. Construction activity includes, but is not limited to, building material storage, waste stockpiling, topsoil stockpiling, equipment storage or parking, disposal of waste materials

of any kind, draining or flushing of tanks, canisters, drums, or other containers, trailer parking or storage, and demolition activity.

B. No traffic, vehicular or pedestrian, shall encroach upon protected areas.

1. This includes, but is not limited to, personal passenger vehicles, construction vehicles, grading machinery, and loading/lifting machinery.

C. No material, machine, vehicle, or part thereof shall encroach above or below the vertical plane of the protective fencing into the protected area.

D. The Contractor shall notify the Landscape Architect of any activity which might infringe or encroach upon the protected area prior to start of said activity.

3.3 ENCROACHMENT UPON PROTECTED AREA

A. If encroachment into the protected area does occur, notify the Landscape Architect immediately.

3.4 ACTIVITY INSIDE PROTECTED AREAS END OF SECTION

A. Clearing and Grubbing:

1. Clearing of small trees, shrubs, and herbaceous plants in the protected area shall be performed by hand only.
2. Bulldozers and/or drag chain operations are not permissible inside protected areas.
3. Grubbing of stumps shall be performed in two (2) ways:
   a. Stumps under 6" diameter shall be pulled by chain.
      1) The vehicle used for pulling shall remain outside the protected area (dripline of the tree to remain) whenever possible.
      2) Under no circumstance shall the pulling vehicle encroach into the protected area by more than 1/3 of the distance from the trunk of tree to remain to the nearest edge of the protected area (dripline).
      3) Any depressions shall be filled with topsoil and leveled to grade by hand.
   b. Stumps over 6" diameter shall be ground out to a depth of 4" below grade.
      1) Stump grinder shall be trailer mounted and maneuvered by light truck or bobcat.
      2) Wood chips generated by grinding shall be removed and any depressions shall be filled with topsoil and leveled to grade.
      3) These operations shall be performed by hand.

B. Grading:

1. Any grading which may be required inside the protected area shall be performed by hand only.
2. No grading or earthmoving machinery shall be allowed inside the protected area.
3. Provide grade stakes and verify grade elevations with the Landscape Architect prior to commencement of any grading activity.

C. Preparation of soil for seeding and/or sodding within the protected areas shall be done by hand or with a power rake and shall not disturb soil more than 2" deep to prevent damage to feeder root systems.

1. No chemical herbicides shall be used within protected areas unless the Contractor can obtain written manufacturer's guarantee that herbicide will not harm tree health or growth and obtain written approval from the Landscape Architect.
2. Contact the Landscape Architect prior to seed or sod preparation within protected areas to determine exact seed and/or sod limits.

D. Stake locations of all utilities which encroach protected areas.

1. Contact the Landscape Architect prior to clearing or trenching for utilities to verify that staked location is the least obtrusive to protected area.

3.5 REMOVAL OF PORTECTIVE FENCING

A. Protective fencing may be removed to facilitate landscape work in the protected area.

1. All Work in the protected area shall be initiated within 24 hours of fence removal.
2. If landscape work in the protected area is delayed or interrupted for more than 24 hours, then protective fencing shall be reinstalled until such time as work in the protected area is resumed.
3. Protective fencing shall be reinstalled after substantial completion of work inside protected area and shall remain until substantial completion of the project or approval of the Landscape Architect, whichever is later.

3.6 DAMAGE COMPENSATION

A. Any damage occurring to trees to remain or protected areas or removal of trees to remain in the protected areas caused by neglect, unauthorized encroachment and/or inadequate protection enforcement as determined by the Landscape Architect shall be the responsibility of the General Contractor.

1. Financial compensation for said damage or removal shall be determined by the Landscape Architect and Owner as per the following guidelines on a per occurrence basis

B. END OF SECTION 015639

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SECTION 016000 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.

B. Related Requirements:

1. Section 011000 "Summary" for Contractor requirements related to Owner-furnished products.
2. Section 012300 "Alternates" for products selected under an alternate.
3. Section 012500 "Substitution Procedures" for requests for post-bid substitutions.
4. Section 014200 "References" for applicable industry standards for products specified.
5. Section 01770 "Closeout Procedures" for submitting warranties.

1.3 DEFINITIONS

A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.

1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.
2. New Products: Items that have not previously been incorporated into another project or facility. Salvaged items or items reused from other projects are not considered new products. Items that are manufactured or fabricated to include recycled content materials are considered new products, unless indicated otherwise.
3. Comparable Product: Product by named manufacturer that is demonstrated and approved through the comparable product submittal process described in Part 2 "Comparable Products" Article, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

B. Basis-of-Design Product Specification: A specification in which a single manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model

number or other designation. Published attributes and characteristics of basis-of-design product establish salient characteristics of products.

1. Evaluation of Comparable Products: In addition to the basis-of-design product description, product attributes and characteristics may be listed to establish the significant qualities related to type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other special features and requirements for purposes of evaluating comparable products of additional manufacturers named in the specification. Manufacturer's published attributes and characteristics of basis-of-design product also establish salient characteristics of products for purposes of evaluating comparable products.

C. Subject to Compliance with Requirements: Where the phrase "Subject to compliance with requirements" introduces a product selection procedure in an individual Specification Section, provide products qualified under the specified product procedure. In the event that a named product or product by a named manufacturer does not meet the other requirements of the specifications, select another named product or product from another named manufacturer that does meet the requirements of the specifications; submit a comparable product request or substitution request, if applicable.

D. Comparable Product Request Submittal: An action submittal requesting consideration of a comparable product, including the following information:

1. Identification of basis-of-design product or fabrication or installation method to be replaced, including Specification Section number and title and Drawing numbers and titles.
2. Data indicating compliance with the requirements specified in Part 2 "Comparable Products" Article.

E. Basis-of-Design Product Specification Submittal: An action submittal complying with requirements in Section 013300 "Submittal Procedures."

F. Substitution: Refer to Section 012500 "Substitution Procedures" for definition and limitations on post-bid substitutions.

1.4 QUALITY ASSURANCE

A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.

1. Resolution of Compatibility Disputes between Multiple Contractors:

a. Contractors are responsible for providing products and construction methods compatible with products and construction methods of other contractors.
b. If a dispute arises between the multiple contractors over concurrently selectable but incompatible products, Architect will determine which products shall be used.

B. Identification of Products: Except for required labels and operating data, do not attach or imprint manufacturer or product names or trademarks on exposed surfaces of products or equipment that will be exposed to view in occupied spaces or on the exterior.

1. Labels: Locate required product labels and stamps on a concealed surface, or, where required for observation following installation, on a visually accessible surface that is not conspicuous.
2. Equipment Nameplates: Provide a permanent nameplate on each item of service- or power-operated equipment. Locate on a visually accessible but inconspicuous surface. Include information essential for operation, including the following:

    a. Name of product and manufacturer.
    b. Model and serial number.
    c. Capacity.
    d. Speed.
    e. Ratings.

3. See individual identification Sections in Divisions 21, 22, 23, and 26 for additional equipment identification requirements.

1.5 COORDINATION

A. Modify or adjust affected work as necessary to integrate work of approved comparable products and approved substitutions.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products, using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.

B. Delivery and Handling:

1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
4. Inspect products on delivery to determine compliance with the Contract Documents and that products are undamaged and properly protected.

C. Storage:

1. Provide a secure location and enclosure at Project site for storage of materials and equipment.

2. Store products to allow for inspection and measurement of quantity or counting of units.
3. Store materials in a manner that will not endanger Project structure.
4. Store products that are subject to damage by the elements under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation and with adequate protection from wind.
5. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
6. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
7. Protect stored products from damage and liquids from freezing.
8. Provide a secure location and enclosure at Project site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.

1.7 PRODUCT WARRANTIES

A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.

1. Manufacturer's Warranty: Written standard warranty form furnished by individual manufacturer for a particular product and issued in the name of the Owner or endorsed by manufacturer to Owner.
2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner and issued in the name of the Owner or endorsed by manufacturer to Owner.

B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.

1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
2. Specified Form: When specified forms are included in the Project Manual, prepare a written document, using indicated form properly executed.
3. See other Sections for specific content requirements and particular requirements for submitting special warranties.

C. Submittal Time: Comply with requirements in Section 017700 "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.

1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
3. Owner reserves the right to limit selection to products with warranties meeting requirements of the Contract Documents.
4. Where products are accompanied by the term "as selected," Architect will make selection.
5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.
6. Or Equal: For products specified by name and accompanied by the term "or equal," "or approved equal," or "or approved," comply with requirements in "Comparable Products" Article to obtain approval for use of an unnamed product.

    a. Submit additional documentation required by Architect through Construction Manager in order to establish equivalency of proposed products. Unless otherwise indicated, evaluation of "or equal" product status is by the Architect, whose determination is final.

B. Product Selection Procedures:

1. Sole Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.

    a. Sole product may be indicated by the phrase "Subject to compliance with requirements, provide the following."

2. Sole Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.

    a. Sole manufacturer/source may be indicated by the phrase "Subject to compliance with requirements, provide products by the following."

3. Limited List of Products: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered unless otherwise indicated.

    a. Limited list of products may be indicated by the phrase "Subject to compliance with requirements, provide one of the following."

4. Non-Limited List of Products: Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed or an unnamed product that complies with requirements.

a. Non-limited list of products is indicated by the phrase "Subject to compliance with requirements, available products that may be incorporated in the Work include, but are not limited to, the following."
b. Provision of an unnamed product is not considered a substitution, if the product complies with requirements.

5. Limited List of Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered unless otherwise indicated.

a. Limited list of manufacturers is indicated by the phrase "Subject to compliance with requirements, provide products by one of the following."

6. Non-Limited List of Manufacturers: Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed or a product by an unnamed manufacturer that complies with requirements.

a. Non-limited list of manufacturers is indicated by the phrase "Subject to compliance with requirements, available manufacturers whose products may be incorporated in the Work include, but are not limited to, the following."
b. Provision of products of an unnamed manufacturer is not considered a substitution, if the product complies with requirements.

7. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications may additionally indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.

a. For approval of products by unnamed manufacturers, comply with requirements in Section 012500 "Substitution Procedures" for substitutions for convenience.

C. Visual Matching Specification: Where Specifications require the phrase "match Architect's sample," provide a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.

1. If no product available within specified category matches and complies with other specified requirements, comply with requirements in Section 012500 "Substitution Procedures" for proposal of product.

D. Visual Selection Specification: Where Specifications include the phrase "as selected by Architect from manufacturer's full range" or a similar phrase, select a product that complies with requirements. Architect will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

2.2 COMPARABLE PRODUCTS

A. Conditions for Consideration of Comparable Products: Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect may return requests without action, except to record noncompliance with the following requirements:

1. Evidence that proposed product does not require revisions to the Contract Documents, is consistent with the Contract Documents, will produce the indicated results, and is compatible with other portions of the Work.
2. Detailed comparison of significant qualities of proposed product with those of the named basis-of-design product. Significant product qualities include attributes, such as type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other specific features and requirements.
3. Evidence that proposed product provides specified warranty.
4. List of similar installations for completed projects, with project names and addresses and names and addresses of architects and owners, if requested.
5. Samples, if requested.

B. Architect's Action on Comparable Products Submittal: If necessary, Architect will request additional information or documentation for evaluation, as specified in Section 013300 "Submittal Procedures."

1. Form of Approval of Submittal: As specified in Section 012500 “Substitution Procedures."
2. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.

C. Submittal Requirements, Two-Step Process: Approval by the Architect of Contractor's request for use of comparable product is not intended to satisfy other submittal requirements. Comply with specified submittal requirements. Obtain Post-Bid Substitution approval prior to full submittal of comparable product.

PART 3 - EXECUTION (Not Used)

END OF SECTION 016000

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SECTION 017300 - EXECUTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes general administrative and procedural requirements governing execution of the Work, including, but not limited to, the following:

1. Construction layout.
2. Field engineering and surveying.
3. Installation of the Work.
4. Cutting and patching.
5. Coordination of Owner's portion of the Work.
6. Coordination of Owner-installed products.
7. Progress cleaning.
8. Starting and adjusting.
9. Protection of installed construction.
10. Correction of the Work.

B. Related Requirements:

1. Section 011000 "Summary" for coordination of Owner-furnished products , Owner's separate contracts, and limits on use of Project site.
2. Section 017700 "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, replacing defective work, and final cleaning.
3. Section 024119 "Selective Demolition" for demolition and removal of selected portions of the building.
4. Section 078413 "Penetration Firestopping" for patching penetrations in fire-rated construction.

1.2 DEFINITIONS

A. Cutting: Removal of in-place construction necessary to permit installation or performance of subsequent work.

B. Patching: Fitting and repair work required to restore construction to original conditions after installation of subsequent work.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For land surveyor.

B. Certificates: Submit certificate signed by land surveyor, certifying that location and elevation of improvements comply with requirements.

C. Landfill Receipts: Submit copy of receipts issued by a landfill facility, licensed to accept hazardous materials, for hazardous waste disposal.

1.4 QUALITY ASSURANCE

A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.

B. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.

1. Structural Elements: When cutting and patching structural elements, or when encountering the need for cutting and patching of elements whose structural function is not known, notify Architect of locations and details of cutting and await directions from Architect before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection.
2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety. Operational elements include the following:

    a. Primary operational systems and equipment.
    b. Fire separation assemblies.
    c. Air or smoke barriers.
    d. Fire-suppression systems.
    e. Plumbing piping systems.
    f. Mechanical systems piping and ducts.
    g. Control systems.
    h. Communication systems.
    i. Fire-detection and -alarm systems.
    j. Conveying systems.
    k. Electrical wiring systems.
    l. Operating systems of special construction.

3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety. Other construction elements include but are not limited to the following:

    a. Water, moisture, or vapor barriers.
    b. Membranes and flashings.
    c. Exterior curtain-wall construction.
    d. Equipment supports.

e. Piping, ductwork, vessels, and equipment.
f. Noise- and vibration-control elements and systems.

4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

C. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of specified products and equipment.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Comply with requirements specified in other Sections.

B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.

1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Architect for the visual and functional performance of in-place materials. Use materials that are not considered hazardous.

C. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities, mechanical and electrical systems, and other construction affecting the Work.

1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, gas service piping, and water-service piping; underground electrical services; and other utilities.
2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.

B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where

indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.

1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

C. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:

1. Description of the Work, including Specification Section number and paragraph, and Drawing sheet number and detail, where applicable.
2. List of detrimental conditions, including substrates.
3. List of unacceptable installation tolerances.
4. Recommended corrections.

D. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Existing Utility Information: Furnish information to local utility that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.

B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to Architect in accordance with requirements in Section 013100 "Project Management and Coordination."

3.3 CONSTRUCTION LAYOUT

A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks and existing conditions. If discrepancies are discovered, notify Architect promptly.

B. Engage a land surveyor experienced in laying out the Work, using the following accepted surveying practices:

1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
2. Establish limits on use of Project site.
3. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
4. Inform installers of lines and levels to which they must comply.
5. Check the location, level and plumb, of every major element as the Work progresses.
6. Notify Architect when deviations from required lines and levels exceed allowable tolerances.
7. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.

C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.

D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.

E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect.

3.4 FIELD ENGINEERING

A. Identification: Owner’s topographic survey will identify existing benchmarks, control points, and property corners.

B. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.

1. Do not change or relocate existing benchmarks or control points without prior written approval of Architect. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Architect before proceeding.
2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.

C. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.

1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.

3.5 INSTALLATION

A. Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.

1. Make vertical work plumb, and make horizontal work level.
2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
4. Maintain minimum headroom clearance of 96 inches in occupied spaces and 90 inches in unoccupied spaces, unless otherwise indicated on Drawings.

B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.

C. Install products at the time and under conditions that will ensure satisfactory results as judged by Architect. Maintain conditions required for product performance until Substantial Completion.

D. Conduct construction operations, so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy of type expected for Project.

E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on-site and placement in permanent locations.

F. Tools and Equipment: Select tools or equipment that minimize production of excessive noise levels.

G. Templates: Obtain and distribute to the parties involved templates for Work specified to be factory prepared and field installed. Check Shop Drawings of other portions of the Work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.

H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions with manufacturer.

1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
2. Allow for building movement, including thermal expansion and contraction.

3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

I. Joints: Make joints of uniform width. Where joint locations in exposed Work are not indicated, arrange joints for the best visual effect, as judged by Architect. Fit exposed connections together to form hairline joints.

3.6 CUTTING AND PATCHING

A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.

1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.

B. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.

C. Temporary Support: Provide temporary support of Work to be cut.

D. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.

E. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching in accordance with requirements in Section 011000 "Summary."

F. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to prevent interruption to occupied areas.

G. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.

1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.

5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
6. Proceed with patching after construction operations requiring cutting are complete.

H. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as practicable, as judged by Architect. Provide materials and comply with installation requirements specified in other Sections, where applicable.

1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.

    a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
    b. Restore damaged pipe covering to its original condition.

3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.

    a. Where patching occurs in a painted surface, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch, corner to corner of wall and edge to edge of ceiling. Provide additional coats until patch blends with adjacent surfaces.

4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.

I. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.7 COORDINATION OF OWNER'S PORTION OF THE WORK

A. Site Access: Provide access to Project site for Owner's construction personnel and Owner's separate contractors.

1. Provide temporary facilities required for Owner-furnished, Contractor-installed and Owner-furnished, Owner-installed products.
2. Refer to Section 011000 "Summary" for other requirements for Owner-furnished, Contractor-installed products.

B. Coordination: Coordinate construction and operations of the Work with work performed by Owner's construction personnel and Owner's separate contractors.

1. Construction Schedule: Inform Owner of Contractor's preferred construction schedule for Owner's portion of the Work. Adjust construction schedule based on a mutually agreeable timetable. Notify Owner if changes to schedule are required due to differences in actual construction progress.
2. Preinstallation Conferences: Include Owner's construction personnel and Owner's separate contractors at preinstallation conferences covering portions of the Work that are to receive Owner's work. Attend preinstallation conferences conducted by Owner's construction personnel if portions of the Work depend on Owner's construction.

3.8 PROGRESS CLEANING

A. Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.

1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F.
3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.

    a. Use containers intended for holding waste materials of type to be stored.

4. Coordinate progress cleaning for joint-use areas where Contractor and other contractors are working concurrently.

B. Site: Maintain Project site free of waste materials and debris.

C. Work Areas: Clean areas where Work is in progress to the level of cleanliness necessary for proper execution of the Work.

1. Remove liquid spills promptly.
2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.

D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.

E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.

F. Exposed Surfaces: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Section 017419 "Construction Waste Management and Disposal."

H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

J. Limiting Exposures: Supervise construction operations to ensure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.9 STARTING AND ADJUSTING

A. Coordinate startup and adjusting of equipment and operating components with requirements in Section 019113 "General Commissioning Requirements."

B. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.

C. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.

D. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

E. Manufacturer's Field Service: Comply with qualification requirements in Section 014000 "Quality Requirements."

3.10 PROTECTION OF INSTALLED CONSTRUCTION

A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.

B. Protection of Existing Items: Provide protection and ensure that existing items to remain undisturbed by construction are maintained in condition that existed at commencement of the Work.

C. Comply with manufacturer's written instructions for temperature and relative humidity.

3.11 CORRECTION OF THE WORK

A. Repair or remove and replace damaged, defective, or nonconforming Work. Restore damaged substrates and finishes.

1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.

B. Repair Work previously completed and subsequently damaged during construction period. Repair to like-new condition.

C. Restore permanent facilities used during construction to their specified condition.

D. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.

E. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.

F. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

END OF SECTION 017300

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SECTION 017419 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for the following:

1. Salvaging nonhazardous demolition waste.
2. Recycling nonhazardous construction waste.
3. Disposing of nonhazardous demolition and construction waste.

B. Related Requirements:

1. Section 042000 "Unit Masonry" for disposal requirements for masonry waste.
2. Section 311000 "Site Clearing" for disposition of waste resulting from site clearing and removal of above- and below-grade improvements.

1.3 DEFINITIONS

A. Construction Waste: Building, structure, and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.

B. Demolition Waste: Building, structure, and site improvement materials resulting from demolition operations.

C. Disposal: Removal of demolition or construction waste and subsequent salvage, sale, recycling, or deposit in landfill, incinerator acceptable to authorities having jurisdiction, or designated spoil areas on Owner’s property.

D. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.

E. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.

F. Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.

1.4 MATERIALS OWNERSHIP

A. Unless otherwise indicated, demolition and construction waste becomes property of Contractor.

B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.

1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.5 INFORMATIONAL SUBMITTALS

A. Records of Donations: Indicate receipt and acceptance of salvageable waste donated to individuals and organizations. Indicate whether organization is tax exempt.

B. Records of Sales: Indicate receipt and acceptance of salvageable waste sold to individuals and organizations. Indicate whether organization is tax exempt.

C. Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable waste by recycling and processing facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

D. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

1.6 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with transportation and disposal regulations of authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General: Practice efficient waste management in the use of materials in the course of the Work. Use all reasonable means to divert construction and demolition waste from landfills and incinerators. Facilitate recycling and salvage of materials.

PART 3 - EXECUTION

3.1 PLAN IMPLEMENTATION

A. General: Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management during the entire duration of the Contract.

1. Comply with operation, termination, and removal requirements in Section 015000 "Temporary Facilities and Controls."

B. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work.

C. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged and recycled.
2. Comply with Section 015000 "Temporary Facilities and Controls" for controlling dust and dirt, environmental protection, and noise control.

3.2 SALVAGING DEMOLITION WASTE

A. Comply with requirements in Section 024119 "Selective Demolition" for salvaging demolition waste.

B. Salvaged Items for Sale and Donation: Not permitted on Project site.

C. Salvaged Items for Owner's Use: Salvage items for Owner's use and handle as follows:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers with label indicating elements, date of removal, quantity, and location where removed.
3. Store items in a secure area until delivery to Owner.
4. Transport items to Owner's storage area designated by Owner.
5. Protect items from damage during transport and storage.

D. Doors and Hardware: Brace open end of door frames. Except for removing door closers, leave door hardware attached to doors.

E. Lighting Fixtures: Separate lamps by type and protect from breakage.

F. Electrical Devices: Separate switches, receptacles, switchgear, transformers, meters, panelboards, circuit breakers, and other devices by type.

3.3 RECYCLING CONSTRUCTION WASTE, GENERAL

A. General: Recycle paper and beverage containers used by on-site workers.

B. Recycling Incentives: Revenues, savings, rebates, tax credits, and other incentives received for recycling waste materials shall be shared equally by Owner and Contractor.

C. Preparation of Waste: Prepare and maintain recyclable waste materials according to recycling or reuse facility requirements. Maintain materials free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to the recycling process.

D. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical according to approved construction waste management plan.

1. Provide appropriately marked containers or bins for controlling recyclable waste until removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.

    a. Inspect containers and bins for contamination and remove contaminated materials if found.

2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
3. Stockpile materials away from construction area. Do not store within drip line of remaining trees.
4. Store components off the ground and protect from the weather.
5. Remove recyclable waste from Owner's property and transport to recycling receiver or processor as often as required to prevent overfilling bins.

3.4 RECYCLING CONSTRUCTION WASTE

A. Packaging:

1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.
2. Polystyrene Packaging: Separate and bag materials.
3. Pallets: As much as possible, require deliveries using pallets to remove pallets from Project site. For pallets that remain on-site, break down pallets into component wood pieces and comply with requirements for recycling wood.
4. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.

B. Wood Materials:

1. Clean Cut-Offs of Lumber: Grind or chip into small pieces.
2. Clean Sawdust: Bag sawdust that does not contain painted or treated wood.

    a. Comply with requirements in Section 329300 "Plants" for use of clean sawdust as organic mulch.

C. Gypsum Board: Stack large clean pieces on wood pallets or in container and store in a dry location.

1. Clean Gypsum Board: Grind scraps of clean gypsum board using small mobile chipper or hammer mill. Screen out paper after grinding.

a. Comply with requirements in Section 329300 "Plants" for use of clean ground gypsum board as inorganic soil amendment.

D. Paint: Seal containers and store by type.

3.5 DISPOSAL OF WASTE

A. General: Except for items or materials to be salvaged or recycled, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.

1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

B. General: Except for items or materials to be salvaged or recycled, remove waste materials and legally dispose of at designated spoil areas on Owner’s property.

C. Burning: Do not burn waste materials.

D. Burning: Burning of waste materials is permitted only at designated areas on Owner's property, provided required permits are obtained. Provide full-time monitoring for burning materials until fires are extinguished.

END OF SECTION 017419

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SECTION 017700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for Contract closeout, including, but not limited to, the following:

1. Substantial Completion procedures.
2. Final completion procedures.
3. Warranties.
4. Final cleaning.

B. Related Requirements:

1. Section 012900 "Payment Procedures" for requirements for Applications for Payment for Substantial Completion and Final Completion.
2. Section 013233 "Photographic Documentation" for submitting Final Completion construction photographic documentation.
3. Section 017823 "Operation and Maintenance Data" for additional operation and maintenance manual requirements.
4. Section 017839 "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
5. Section 017900 "Demonstration and Training" for requirements to train the Owner's maintenance personnel to adjust, operate, and maintain products, equipment, and systems.

1.3 DEFINITIONS

A. List of Incomplete Items: Contractor-prepared list of items to be completed or corrected, prepared for the Architect's use prior to Architect's inspection, to determine if the Work is substantially complete.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of cleaning agent.

B. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.

C. Certified List of Incomplete Items: Final submittal at Final Completion.

1.5 CLOSEOUT SUBMITTALS

A. Certificates of Release (Occupancy): From authorities having jurisdiction.

B. Certificate of Insurance: For continuing coverage.

C. Field Report: For pest-control inspection.

D. Closeout Forms as attached to the end of this Section:

1. Close-Out Form “A - Subcontractor’s Affidavit of Release of Lien.
2. Close-Out Form “B” – Certification of Project Compliance.
3. Close-Out Form “C” – Subcontractor Hazardous Material Certification.
4. Close-Out Form “D” – Subcontractor Warranty.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Schedule of Maintenance Material Items: For maintenance material submittal items required by other Sections.

1.7 SUBSTANTIAL COMPLETION PROCEDURES

A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's "punch list"), indicating the value of each item on the list and reasons why the Work is incomplete.

B. Submittals Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction, permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
2. Submit closeout submittals specified in other Division 01 Sections, including Project Record Documents, operation and maintenance manuals, damage or settlement surveys, property surveys, and similar final record information.
3. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
4. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Architect. Label with manufacturer's name and model number.

a. Schedule of Maintenance Material Items: Prepare and submit schedule of maintenance material submittal items, including name and quantity of each item and name and number of related Specification Section. Obtain Architect's and Owner's signature for receipt of submittals.

5. Submit testing, adjusting, and balancing records.
6. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.

C. Procedures Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

1. Advise Owner of pending insurance changeover requirements if any.
2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
3. Complete startup and testing of systems and equipment.
4. Perform preventive maintenance on equipment used prior to Substantial Completion.
5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings specified in Section 017900 "Demonstration and Training."
6. Advise Owner of changeover in utility services.
7. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
9. Complete final cleaning requirements.
10. Touch up paint and otherwise repair and restore marred exposed finishes to eliminate visual defects.

D. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 10 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.

1. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
2. Results of completed inspection will form the basis of requirements for Final Completion.

1.8 FINAL COMPLETION PROCEDURES

A. Submittals Prior to Final Completion: Before requesting final inspection for determining Final Completion, complete the following:

1. Submit a final Application for Payment in accordance with Section 012900 "Payment Procedures."

2. Certified List of Incomplete Items: Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
4. Submit pest-control final inspection report.
5. Submit Final Completion photographic documentation.

B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 10 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.

1. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.9 LIST OF INCOMPLETE ITEMS

A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.

1. Organize list of spaces in sequential order, starting with exterior areas first and proceeding from lowest floor to highest floor, listed by room or space number.
2. Organize items applying to each space by major element, including categories for ceilings, individual walls, floors, equipment, and building systems.
3. Include the following information at the top of each page:

    a. Project name.
    b. Date.
    c. Name of Architect.
    d. Name of Contractor.
    e. Page number.

4. Submit list of incomplete items in the following format:

    a. Web-Based Project Software Upload: Utilize software feature for creating and updating list of incomplete items (punch list).

1.10 SUBMITTAL OF PROJECT WARRANTIES

A. Time of Submittal: Submit written warranties on request of Architect for designated portions of the Work where warranties are indicated to commence on dates other than date of Substantial Completion, or when delay in submittal of warranties might limit Owner's rights under warranty.

B. Partial Occupancy: Submit properly executed warranties within 15 days of completion of designated portions of the Work that are completed and occupied or used by Owner during construction period by separate agreement with Contractor.

C. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.

D. Warranty Electronic File: Provide warranties and bonds in PDF format. Assemble complete warranty and bond submittal package into a single electronic PDF file with bookmarks enabling navigation to each item. Provide bookmarked table of contents at beginning of document.

1. Submit on digital media acceptable to Architect and by uploading to web-based project software site.

E. Warranties in Paper Form:

1. Bind warranties and bonds in heavy-duty, three-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.
2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.

F. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

PART 3 - EXECUTION

3.1 FINAL CLEANING

A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.

B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.

1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:

a. Clean Project site of rubbish, waste material, litter, and other foreign substances.
b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
c. Rake grounds that are not planted, mulched, or paved to a smooth, even-textured surface.
d. Remove tools, construction equipment, machinery, and surplus material from Project site.
e. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
f. Remove debris and surface dust from limited-access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
g. Clean flooring, removing debris, dirt, and staining; clean according to manufacturer's recommendations.
h. Vacuum and mop concrete.
i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
j. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Polish mirrors and glass, taking care not to scratch surfaces.
k. Remove labels that are not permanent.
l. Wipe surfaces of mechanical and electrical equipment, elevator equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
m. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
n. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
o. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter on inspection.
p. Clean luminaires, lamps, globes, and reflectors to function with full efficiency.
q. Clean strainers.
r. Leave Project clean and ready for occupancy.

C. Pest Control: Comply with pest control requirements in Section 015000 "Temporary Facilities and Controls." Prepare written report.

D. Construction Waste Disposal: Comply with waste-disposal requirements in Section 017419 "Construction Waste Management and Disposal."

3.2 REPAIR OF THE WORK

A. Complete repair and restoration operations required by Section 017300 "Execution" before requesting inspection for determination of Substantial Completion.

END OF SECTION 017700

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CLOSE-OUT FORM "A"

SUBCONTRACTOR'S AFFIDAVIT OF RELEASE OF LIEN

STATE OF _____

COUNTY OF _____

KNOW ALL MEN BY THESE PRESENTS:

_____, being first duly sworn, deposes and says:

1. That he / she is the _____ of _____, the subcontractor who supplied, installed, and /or erected the work described below, and that, he /she is duly authorized to make this Affidavit and Subcontractor Release:

   Project: Schindewolf Gym Addition

   Owner: Klein Independent School District Architect: DLR Group inc of Texas

   Work Performed: _____ Specification Section(s): _____

2. That all work required under the subject subcontractor of the subject construction project has been performed in accordance with the terms thereof, that all material men, sub-subcontractors, mechanics, and laborers have been paid and satisfied in full and that there are no outstanding claims of any character arising out of the performance of said subcontractor which have not been paid and satisfied in full.

1. That to the best of his / her knowledge and belief, there are no unsatisfied claims for damages resulting from injury or death to any employees, sub-subcontractors, or the public at large arising out of the performance of said subcontract, or any suits or claims for any other damages of any kind, nature, or description which might constitute a lien upon the property of the Owner.

2. That he / she has received full payment of all sums due him / her for materials furnished and services rendered by the undersigned in connection with the performance of said subcontract and has and does hereby release the Owner and the Architect and his consultants and the Contractor from any and all claims of any character arising out of or in any way connected with performance of said subcontract.

ATTEST (If Corporation)

_____
Name of Subcontractor

_____ _____
Secretary (By) (Title)

JURAT

STATE OF _____

COUNTY OF _____

Sworn to and subscribed before me on this _____ day of _____, 20_____.

(Seal)

_____
(Notary Public Signature

CLOSE OUT FORM "B"

CERTIFICATION OF PROJECT COMPLIANCE

Completion of this form is required under the provisions of §61.1036(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

Facility: Schindewolf Gym Addition

Address: 20903 Ella Blvd

City: Spring, Texas 77388

DISTRICT: Klein Independent School District

ARCHITECT/ENGINEER: DLR Group inc of Texas

CONTRACTOR:

CONTRACT DATE:

DATE DISTRICT AUTHORIZED PROJECT:

BRIEF DESCRIPTION OF PROJECT: Gymnasium and adjacent support spaces addition to the existing school that has a gross area of thirteen thousand (13,000) square feet and renovation work at the existing facility.

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: **BY:** **DATE:**

4. The Architect/Engineer certifies the above information was received from the school district, and that the building(s) were designed in accordance with the applicable building codes. Further, the 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: **BY:** **DATE:**

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

CONTRACTOR: **BY:** **DATE:**

6. The District certifies completion of the project (as defined by the Architect/Engineer and Contractor).

DISTRICT: **BY:** **DATE:**

INSTRUCTIONS FOR COMPLETION OF "CERTIFICATION OF PROJECT COMPLIANCE" FORM

Section 1. Identify the following:
- name and address of the school facility
- name of the school district
- the Architect/Engineer and Contractor
- the date of execution of the construction contract
- the date that the school district authorized the superintendent to hire an architect/engineer
- scope of the project.

Section 2. This section outlines the intent of the document. No action required.

Section 3. This section is to be executed by the school district upon transmittal of the information (as listed) to the architect/engineer and is to remain in the custody of the school district throughout the entire project.

Section 4. This section is to be executed by the architect/engineer upon completion of the plans and specifications and in conjunction with the completion of the plan review for code compliance (ref. 19 TAC §61.1033 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.

CLOSE-OUT FORM "C"

SUBCONTRACTOR HAZARDOUS MATERIAL

CERTIFICATE

THE STATE OF _____

COUNTY OF _____

PROJECT: Schindewolf Gym Addition

OWNER: Klein Independent School District

ARCHITECT: DLR GROUP inc of Texas

SPECIFICATION SECTION(S):

KNOW ALL MEN BY THESE PRESENTS:

_____, being first duly sworn, deposes and says that he / she is the _____of_____,the subcontractor / supplier who constructed or provided the section(s) of work referenced above, and that he / she is duly authorized to certify to the best of his / her information, knowledge, and belief no asbestos, lead or PCB containing products have been incorporated into the project.

ATTEST (If Corporation)

_____
Name of Subcontractor / Supplier

_____ _____
Secretary (By) (Title)

JURAT

THE STATE OF _____

COUNTY OF _____

Sworn to and subscribed before me on this_____day of_____, 20_____.

_____
(Seal) (Notary Public Signature)

CLOSE-OUT FORM "D"

SUBCONTRACTOR

WARRANTY

STATE OF _____

COUNTY OF _____

KNOW ALL MEN BY THESE PRESENTS:

_____, being first duly sworn, deposes and says:

1. That he / she is the Subcontractor (or the _____ of _____ the subcontract / she is duly authorized to make this Subcontractor Warranty:

   Project: Schindewolf Gym Addition

   Owner: Klein Independent School District Architect: DLR Group inc of Texas

   Work Performed: _____ Specification Section(s): _____

2. The undersigned Contractor warrants to the Owner and Architect that materials and equipment furnished under the Contract are of good quality and new except where otherwise required or permitted by the Contract Documents, that the Work is free from defects not inherent in the quality required or permitted, and that the Work conforms with the requirements of the Contract Documents. Work not conforming to these requirements, including substitutions not properly approved and authorized, may be considered defective. The Subcontractor's warranty excludes remedy for damage or defect caused by abuse, modifications not executed by the Subcontractor, improper or insufficient maintenance, improper operation, or normal wear and tear under normal usage.

1. In the event of failure of materials, products, or workmanship, during the specified warranty periods, the Subcontractor shall take appropriate measures to assure correction or replacement of the defective items, whether notified by the Contractor, Owner or Architect.

2. The Subcontractor warrants the work performed for a period of _____ months from the date of Substantial Completion, except as follows: _____

ATTEST (If Corporation) _____ Name of Subcontractor

Secretary (By) (Title)

JURAT

STATE OF _____

COUNTY OF _____

Sworn to and subscribed before me on this _____ day of _____, 20____.

_____

(Seal) (Notary Public Signature

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SECTION 017823 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:

1. Emergency manuals.
2. Systems and equipment operation manuals.
3. Systems and equipment maintenance manuals.
4. Product maintenance manuals.

B. Related Requirements:

1. Section 013300 "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.
2. Section 019113 "General Commissioning Requirements" for verification and compilation of data into operation and maintenance manuals.

1.3 DEFINITIONS

A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.

B. Subsystem: A portion of a system with characteristics similar to a system.

1.4 CLOSEOUT SUBMITTALS

A. Submit operation and maintenance manuals indicated. Provide content for each manual as specified in individual Specification Sections, and as reviewed and approved at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.

1. Architect and Commissioning Authority will comment on whether content of operation and maintenance submittals is acceptable.
2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.

B. Format: Submit operation and maintenance manuals in the following format:

1. Submit by uploading to web-based project software site. Enable reviewer comments on draft submittals.

C. Initial Manual Submittal: Submit draft copy of each manual at least 30 days before commencing demonstration and training. Architect and Commissioning Authority will comment on whether general scope and content of manual are acceptable.

1. Correct or revise each manual to comply with Architect's and Commissioning Authority's comments. Submit copies of each corrected manual within 15 days of receipt of Architect's and Commissioning Authority's comments and prior to commencing demonstration and training.

D. Final Manual Submittal: Submit each manual in final form prior to Final Completion.

E. Comply with Section 017700 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

1.5 FORMAT OF OPERATION AND MAINTENANCE MANUALS

A. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.

1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
2. File Names and Bookmarks: Bookmark individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.

1.6 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

A. Organization of Manuals: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:

1. Title page.
2. Table of contents.
3. Manual contents.

B. Title Page: Include the following information:

1. Subject matter included in manual.
2. Name and address of Project.

3. Name and address of Owner.
4. Date of submittal.
5. Name and contact information for Contractor.
6. Name and contact information for Construction Manager.
7. Name and contact information for Architect.
8. Name and contact information for Commissioning Authority.
9. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
10. Cross-reference to related systems in other operation and maintenance manuals.

C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.

1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.

D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.

E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

1.7 EMERGENCY MANUALS

A. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.

B. Content: Organize manual into a separate section for each of the following:

1. Type of emergency.
2. Emergency instructions.
3. Emergency procedures.

C. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:

1. Fire.
2. Flood.
3. Gas leak.
4. Water leak.
5. Power failure.
6. Water outage.

7. System, subsystem, or equipment failure.
8. Chemical release or spill.

D. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.

E. Emergency Procedures: Include the following, as applicable:

1. Instructions on stopping.
2. Shutdown instructions for each type of emergency.
3. Operating instructions for conditions outside normal operating limits.
4. Required sequences for electric or electronic systems.
5. Special operating instructions and procedures.

1.8 SYSTEMS AND EQUIPMENT OPERATION MANUALS

A. Systems and Equipment Operation Manual: Assemble a complete set of data indicating operation of each system, subsystem, and piece of equipment not part of a system. Include information required for daily operation and management, operating standards, and routine and special operating procedures.

1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.

B. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:

1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
2. Performance and design criteria if Contractor has delegated design responsibility.
3. Operating standards.
4. Operating procedures.
5. Operating logs.
6. Wiring diagrams.
7. Control diagrams.
8. Piped system diagrams.
9. Precautions against improper use.
10. License requirements including inspection and renewal dates.

C. Descriptions: Include the following:

1. Product name and model number. Use designations for products indicated on Contract Documents.
2. Manufacturer's name.
3. Equipment identification with serial number of each component.
4. Equipment function.

5. Operating characteristics.
6. Limiting conditions.
7. Performance curves.
8. Engineering data and tests.
9. Complete nomenclature and number of replacement parts.

D. Operating Procedures: Include the following, as applicable:

1. Startup procedures.
2. Equipment or system break-in procedures.
3. Routine and normal operating instructions.
4. Regulation and control procedures.
5. Instructions on stopping.
6. Normal shutdown instructions.
7. Seasonal and weekend operating instructions.
8. Required sequences for electric or electronic systems.
9. Special operating instructions and procedures.

E. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.

F. Piped Systems: Diagram piping as installed, and identify color coding where required for identification.

1.9 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

A. Systems and Equipment Maintenance Manuals: Assemble a complete set of data indicating maintenance of each system, subsystem, and piece of equipment not part of a system. Include manufacturers' maintenance documentation, preventive maintenance procedures and frequency, repair procedures, wiring and systems diagrams, lists of spare parts, and warranty information.

1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.

B. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranties and bonds as described below.

C. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.

D. Manufacturers' Maintenance Documentation: Include the following information for each component part or piece of equipment:

1. Standard maintenance instructions and bulletins; include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.

    a. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.

2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
3. Identification and nomenclature of parts and components.
4. List of items recommended to be stocked as spare parts.

E. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:

1. Test and inspection instructions.
2. Troubleshooting guide.
3. Precautions against improper maintenance.
4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
5. Aligning, adjusting, and checking instructions.
6. Demonstration and training video recording, if available.

F. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.

1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.

G. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.

H. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.

I. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

1. Include procedures to follow and required notifications for warranty claims.

J. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.

1. Do not use original project record documents as part of maintenance manuals.

1.10 PRODUCT MAINTENANCE MANUALS

A. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.

B. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.

C. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.

D. Product Information: Include the following, as applicable:

1. Product name and model number.
2. Manufacturer's name.
3. Color, pattern, and texture.
4. Material and chemical composition.
5. Reordering information for specially manufactured products.

E. Maintenance Procedures: Include manufacturer's written recommendations and the following:

1. Inspection procedures.
2. Types of cleaning agents to be used and methods of cleaning.
3. List of cleaning agents and methods of cleaning detrimental to product.
4. Schedule for routine cleaning and maintenance.
5. Repair instructions.

F. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.

G. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

1. Include procedures to follow and required notifications for warranty claims.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 017823

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SECTION 017839 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for Project Record Documents, including the following:

1. Record Drawings.
2. Record specifications.
3. Record Product Data.

B. Related Requirements:

1. Section 017700 "Closeout Procedures" for general closeout procedures.
2. Section 017823 "Operation and Maintenance Data" for operation and maintenance manual requirements.

1.3 CLOSEOUT SUBMITTALS

A. Record Drawings: Comply with the following:

1. Number of Copies: Submit copies of Record Drawings as follows:

a. Initial Submittal:

1) Submit PDF electronic files of scanned record prints.
2) Architect will indicate whether general scope of changes, additional information recorded are acceptable.

b. Final Submittal:

1) Submit one paper-PDF electronic files of marked-up record prints.
2) Submit Record Digital Data Files in AutoCAD format (.dwg) and one set(s) of Record Digital Data File full-size plots.
3) Plot each drawing file, whether or not changes and additional information were recorded.

B. Record Specifications: Submit annotated PDF electronic files of Project's Specifications, including addenda and Contract modifications.

C. Record Product Data: Submit annotated PDF electronic files and directories of each submittal.

1. Where record Product Data are required as part of operation and maintenance manuals, submit duplicate marked-up Product Data as a component of manual.

1.4 RECORD DRAWINGS

A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.

1. Preparation: Mark record prints to show the actual installation, where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.

a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
b. Accurately record information in an acceptable drawing technique.
c. Record data as soon as possible after obtaining it.
d. Record and check the markup before enclosing concealed installations.
e. Cross-reference record prints to corresponding photographic documentation.

2. Content: Types of items requiring marking include, but are not limited to, the following:

a. Dimensional changes to Drawings.
b. Revisions to details shown on Drawings.
c. Depths of foundations.
d. Locations and depths of underground utilities.
e. Revisions to routing of piping and conduits.
f. Revisions to electrical circuitry.
g. Actual equipment locations.
h. Duct size and routing.
i. Locations of concealed internal utilities.
j. Changes made by Change Order or Construction Change Directive.
k. Changes made following Architect's written orders.
l. Details not on the original Contract Drawings.
m. Field records for variable and concealed conditions.
n. Record information on the Work that is shown only schematically.

3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
4. Mark record prints with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
5. Mark important additional information that was either shown schematically or omitted from original Drawings.
6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.

B. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked-up record prints with Architect. When authorized, prepare a full set of corrected digital data files of the Contract Drawings, as follows:

1. Format: DWG, Version 2024, Microsoft Windows operating system.
2. Format: Annotated PDF electronic file with comment function enabled.
3. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
4. Refer instances of uncertainty to Architect for resolution.
5. Architect will furnish Contractor with one set of digital data files of the Contract Drawings for use in recording information.

    a. See Section 013100 "Project Management and Coordination" for requirements related to use of Architect's digital data files.
    b. Architect will provide data file layer information. Record markups in separate layers.

C. Format: Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.

1. Record Prints: Organize record prints into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
2. Format: Annotated PDF electronic file with comment function enabled.
3. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.
4. Identification: As follows:

    a. Project name.
    b. Date.
    c. Designation "PROJECT RECORD DRAWINGS."
    d. Name of Architect.
    e. Name of Contractor.

1.5 RECORD SPECIFICATIONS

A. Preparation: Mark Specifications to indicate the actual product installation, where installation varies from that indicated in Specifications, addenda, and Contract modifications.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Note related Change Orders and Record Drawings where applicable.

B. Format: Submit record specifications as annotated PDF electronic file.

1.6 RECORD PRODUCT DATA

A. Recording: Maintain one copy of each submittal during the construction period for Project Record Document purposes. Post changes and revisions to Project Record Documents as they occur; do not wait until end of Project.

B. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
3. Note related Change Orders, Record Specifications, and Record Drawings where applicable.

C. Format: Submit Record Product Data as annotated PDF electronic file.

1. Include Record Product Data directory organized by Specification Section number and title, electronically linked to each item of Record Product Data.

1.7 MAINTENANCE OF RECORD DOCUMENTS

A. Maintenance of Record Documents: Store Record Documents in the field office apart from the Contract Documents used for construction. Do not use Project Record Documents for construction purposes. Maintain Record Documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to Project Record Documents for Architect's reference during normal working hours.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 017839

SECTION 017900 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:

1. Instruction in operation and maintenance of systems, subsystems, and equipment.
2. Demonstration and training video recordings.

1.3 INFORMATIONAL SUBMITTALS

A. Instruction Program: Submit outline of instructional program for demonstration and training, including a list of training modules and a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.

1. Indicate proposed training modules using manufacturer-produced demonstration and training video recordings for systems, equipment, and products in lieu of video recording of live instructional module.

B. Qualification Data: For instructor and videographer.

C. Attendance Record: For each training module, submit list of participants and length of instruction time.

1.4 CLOSEOUT SUBMITTALS

A. Demonstration and Training Video Recordings: Submit two copies within fourteen days of end of each training module.

1. Identification: On each copy, provide an applied label with the following information:

a. Name of Project.
b. Name and address of videographer.
c. Name of Architect.
d. Name of Contractor.
e. Date of video recording.

2. At completion of training, submit complete training manual(s) for Owner's use prepared in same format required for operation and maintenance manuals specified in Section 017823 "Operation and Maintenance Data."

1.5 QUALITY ASSURANCE

A. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Section 014000 "Quality Requirements," experienced in operation and maintenance procedures and training.

B. Videographer Qualifications: A professional videographer who is experienced photographing demonstration and training events similar to those required.

1.6 COORDINATION

A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of Owner's personnel.

B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.

C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data have been reviewed and approved by Architect.

1.7 INSTRUCTION PROGRAM

A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.

B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:

1. Basis of System Design, Operational Requirements, and Criteria: Include the following:

    a. System, subsystem, and equipment descriptions.
    b. Performance and design criteria if Contractor is delegated design responsibility.
    c. Operating standards.
    d. Regulatory requirements.
    e. Equipment function.
    f. Operating characteristics.
    g. Limiting conditions.
    h. Performance curves.

2. Documentation: Review the following items in detail:

    a. Emergency manuals.
    b. Systems and equipment operation manuals.
    c. Systems and equipment maintenance manuals.
    d. Product maintenance manuals.
    e. Project Record Documents.
    f. Identification systems.
    g. Warranties and bonds.
    h. Maintenance service agreements and similar continuing commitments.

3. Emergencies: Include the following, as applicable:

    a. Instructions on meaning of warnings, trouble indications, and error messages.
    b. Instructions on stopping.
    c. Shutdown instructions for each type of emergency.
    d. Operating instructions for conditions outside of normal operating limits.
    e. Sequences for electric or electronic systems.
    f. Special operating instructions and procedures.

4. Operations: Include the following, as applicable:

    a. Startup procedures.
    b. Equipment or system break-in procedures.
    c. Routine and normal operating instructions.
    d. Regulation and control procedures.
    e. Control sequences.
    f. Safety procedures.
    g. Instructions on stopping.
    h. Normal shutdown instructions.
    i. Operating procedures for emergencies.
    j. Operating procedures for system, subsystem, or equipment failure.
    k. Seasonal and weekend operating instructions.
    l. Required sequences for electric or electronic systems.
    m. Special operating instructions and procedures.

5. Adjustments: Include the following:

    a. Alignments.
    b. Checking adjustments.
    c. Noise and vibration adjustments.
    d. Economy and efficiency adjustments.

6. Troubleshooting: Include the following:

    a. Diagnostic instructions.
    b. Test and inspection procedures.

7. Maintenance: Include the following:

a. Inspection procedures.
b. Types of cleaning agents to be used and methods of cleaning.
c. List of cleaning agents and methods of cleaning detrimental to product.
d. Procedures for routine cleaning.
e. Procedures for preventive maintenance.
f. Procedures for routine maintenance.
g. Instruction on use of special tools.

8. Repairs: Include the following:

a. Diagnosis instructions.
b. Repair instructions.
c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
d. Instructions for identifying parts and components.
e. Review of spare parts needed for operation and maintenance.

C. Video Recordings: At a minimum, provide the following video recordings for demonstration and training modules:

1. Coiling overhead doors
2. Door Hardware and automatic door operators.
3. Gymnasium equipment and control panel.
4. Telescopic stands.
5. Fire suppression system.
6. All HVAC equipment and controls.
7. All electrical power systems.
8. Special systems including fire alarm system.

1.8 PREPARATION

A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Section 017823 "Operation and Maintenance Data."

B. Set up instructional equipment at instruction location.

1.9 INSTRUCTION

A. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.

1. Architect will furnish an instructor to describe basis of system design, operational requirements, criteria, and regulatory requirements.
2. Owner will furnish an instructor to describe Owner's operational philosophy.
3. Owner will furnish Contractor with names and positions of participants.

B. Scheduling: Provide instruction at mutually agreed-on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.

1. Schedule training with Owner, through Architect, with at least seven days' advance notice.

C. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.

D. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of a demonstration performance-based test.

E. Cleanup: Collect used and leftover educational materials and remove from Project site. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

1.10 DEMONSTRATION AND TRAINING VIDEO RECORDINGS

A. General: Engage a qualified commercial videographer to record demonstration and training video recordings. Record each training module separately. Include classroom instructions and demonstrations, board diagrams, and other visual aids, but not student practice.

1. At beginning of each training module, record each chart containing learning objective and lesson outline.

B. Digital Video Recordings: Provide high-resolution, digital video in MPEG format, produced by a digital camera with minimum sensor resolution of 12 megapixels and capable of recording in full HD mode with vibration reduction technology.

1. Submit video recordings on CD-ROM or thumb drive and by uploading to web-based Project software site.
2. File Hierarchy: Organize folder structure and file locations according to Project Manual table of contents. Provide complete screen-based menu.
3. File Names: Utilize file names based on name of equipment generally described in video segment, as identified in Project specifications.
4. Contractor and Installer Contact File: Using appropriate software, create a file for inclusion on the equipment demonstration and training recording that describes the following for each Contractor involved on the Project, arranged according to Project Manual table of contents:

a. Name of Contractor/Installer.
b. Business address.
c. Business phone number.
d. Point of contact.
e. Email address.

C. Recording: Mount camera on tripod before starting recording, unless otherwise necessary to adequately cover area of demonstration and training. Display continuous running time.

1. Film training session(s) in segments not to exceed 15 minutes.

    a. Produce segments to present a single significant piece of equipment per segment.
    b. Organize segments with multiple pieces of equipment to follow order of Project Manual table of contents.
    c. Where a training session on a particular piece of equipment exceeds 15 minutes, stop filming and pause training session. Begin training session again upon commencement of new filming segment.

D. Light Levels: Verify light levels are adequate to properly light equipment. Verify equipment markings are clearly visible prior to recording.

1. Furnish additional portable lighting as required.

E. Narration: Describe scenes on video recording by audio narration by microphone while video recording is recorded. Include description of items being viewed.

F. Preproduced Video Recordings: Provide video recordings used as a component of training modules in same format as recordings of live training.

PART 2 - PRODUCTS

PART 3 - EXECUTION

END OF SECTION 017900

SECTION 019113 - GENERAL COMMISSIONING REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

B. Owner's Project Requirements and Basis-of-Design Document are included by reference for information only.

1.2 SUMMARY

A. Section Includes:

1. General requirements for coordinating and scheduling commissioning activities.
2. Commissioning meetings.
3. Commissioning reports.
4. Use of commissioning process test equipment, instrumentation, and tools.
5. Construction checklists, including, but not limited to, installation checks, startup, performance tests, and performance test demonstration.
6. Commissioning tests and commissioning test demonstration.
7. Adjusting, verifying, and documenting identified systems and assemblies.

B. Related Requirements:

1. Section 013300 "Submittal Procedures" for submittal procedure requirements for commissioning process.
2. Section 017700 "Closeout Procedures" for Certificate of Construction-Phase Commissioning Process Completion submittal requirements.
3. Section 017823 "Operation and Maintenance Data" for preliminary operation and maintenance data submittal requirements.
4. Section 230800 "Commissioning of HVAC" for technical commissioning requirements for HVAC.
5. Section 260800 "Commissioning of Electrical Systems" for technical commissioning requirements for electrical systems.

1.3 DEFINITIONS

A. Acceptance Criteria: Threshold of acceptable work quality or performance specified for a commissioning activity, including, but not limited to, construction checklists, performance tests, performance test demonstrations, commissioning tests, and commissioning test demonstrations.

B. Basis-of-Design Document: The Construction Documents prepared by Architect that records concepts, calculations, decisions, and product selections used to comply with Owner's Project Requirements and to suit applicable regulatory requirements, standards, and guidelines.

C. Commissioning Authority: An entity engaged by Owner to evaluate Commissioning-Process Work.

D. Commissioning Plan: A document, prepared by Commissioning Authority, that outlines the organization, schedule, allocation of resources, and documentation of commissioning requirements.

E. Commissioning: A quality-focused process for verifying and documenting that the facility and all of its systems and assemblies are planned, designed, installed, and tested to comply with Owner's Project Requirements. The requirements specified here are limited to the construction phase commissioning activities.

F. Construction-Phase Commissioning-Process Completion: The stage of completion and acceptance of commissioning process when resolution of deficient conditions and issues discovered during commissioning process and retesting until acceptable results are obtained has been accomplished. Owner will establish in writing the date construction-phase commissioning-process completion is achieved. See Section 017700 "Closeout Procedures" for Certificate of Construction-Phase Commissioning Process Completion submittal requirements.

1. Commissioning process is complete when the Work specified of this Section and related Sections has been completed and accepted, including, but not limited to, the following:

    a. Completion of tests and acceptance of test results.
    b. Resolution of issues, as verified by retests performed and documented with acceptance of retest results.
    c. Comply with requirements in Section 017900 "Demonstration and Training."
    d. Completion and acceptance of submittals and reports.

G. Owner's Project Requirements: A document that details the functional requirements of a project and the expectations of how it will be used and operated, including Project goals, measurable performance criteria, cost considerations, benchmarks, success criteria, and supporting information. This document is prepared either by the Owner or for the Owner by the Architect or Commissioning Authority.

H. Owner's Witness: Commissioning Authority, Owner's Project Manager, or Architect-designated witness authorized to authenticate test demonstration data and to sign completed test data forms.

I. "Systems," "Assemblies," "Subsystems," "Equipment," and "Components": Where these terms are used together or separately, they shall mean "as-built" systems, assemblies, subsystems, equipment, and components.

J. Test: Performance tests, performance test demonstrations, commissioning tests, and commissioning test demonstrations.

1.4 COMMISSIONING TEAM

A. Members Appointed by Contractor(s):

1. Commissioning Coordinator: A person or entity employed by Contractor to manage, schedule, and coordinate commissioning process. The Commissioning Coordinator shall be familiar with the all the commissioning specifications included in the Project.
2. Project superintendent and other employees that Contractor may deem appropriate for a particular portion of the commissioning process.
3. Subcontractors, installers, suppliers, and specialists that Contractor may deem appropriate for a particular portion of the commissioning process.
4. Appointed team members shall have the authority to act on behalf of the entity they represent.

B. Members Appointed by Owner:

1. Commissioning Authority, plus consultants that Commissioning Authority may deem appropriate for a particular portion of the commissioning process.
2. Owner representative(s), facility operations and maintenance personnel, plus other employees, separate contractors, and consultants that Owner may deem appropriate for a particular portion of the commissioning process.
3. Architect, plus employees and consultants that Architect may deem appropriate for a particular portion of the commissioning process.

1.5 INFORMATIONAL SUBMITTALS

A. Comply with requirements in Section 013300 "Submittal Procedures" for submittal procedure general requirements for commissioning process.

B. Commissioning Plan Information:

1. List of Contractor-appointed commissioning team members to include specific personnel and subcontractors performing the various commissioning requirements.
2. Schedule of commissioning activities, integrated with the Construction Schedule. Comply with requirements in Section 013200 "Construction Progress Documentation" for the Construction Schedule general requirements for commissioning process.
3. Contractor personnel and subcontractors participating in each test.
4. List of instrumentation required for each test to include identification of parties that will provide instrumentation for each test.

C. Commissioning schedule.

D. Two-week look-ahead schedules.

E. Commissioning Coordinator Letter of Authority:

1. Within 10 days after approval of Commissioning Coordinator qualifications, submit a letter of authority for Commissioning Coordinator, signed by a principal of Contractor's firm. Letter shall authorize Commissioning Coordinator to do the following:

a. Make inspections required for commissioning process.
b. Coordinate, schedule, and manage commissioning process of Contractor, subcontractors, and suppliers.
c. Obtain documentation required for commissioning process from Contractor, subcontractors, and suppliers.
d. Report issues, delayed resolution of issues, schedule conflicts, and lack of cooperation or expertise on the part of members of the commissioning team.

F. Commissioning Coordinator Qualification Data: For entity coordinating Contractor's commissioning activities to demonstrate their capabilities and experience.

1. Experienced: When used with an entity or individual, "experienced" means having successfully completed a minimum of three previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

G. List test instrumentation, equipment, and monitoring devices. Include the following information:

1. Make, model, serial number, and application for each instrument, equipment, and monitoring device.
2. Brief description of intended use.
3. Calibration record showing the following:

a. Calibration agency, including name and contact information.
b. Last date of calibration.
c. Range of values for which calibration is valid.
d. Certification of accuracy.
e. Certification for calibration equipment traceable to NIST.
f. Due date of the next calibration.

H. Test Reports:

1. Pre-Startup Report: Prior to startup of equipment or a system, submit signed, completed construction checklists.
2. Test Data Reports: At the end of each day in which tests are conducted, submit test data for tests performed.
3. Commissioning Issue Reports: Daily, at the end of each day in which tests are conducted, submit commissioning issue reports for tests for which acceptable results were not achieved.
4. Weekly Progress Report: Weekly, at the end of each week in which tests are conducted, submit a progress report.
5. Data Trend Logs: Submit data trend logs at the end of the trend log period.
6. System Alarm Logs: Daily, at the start of days following a day in which tests were performed, submit printout of log of alarms that occurred since the last log was printed.

I. Construction Checklists:

1. Material checks.
2. Installation checks.

3. Startup procedures, where required.

1.6 CLOSEOUT SUBMITTALS

A. Commissioning Report:

1. At Construction-Phase Commissioning Completion, include the following:

a. Pre-startup reports.
b. Approved test procedures.
c. Test data forms, completed and signed.
d. Progress reports.
e. Commissioning issue report log.
f. Commissioning issue reports showing resolution of issues.
g. Correspondence or other documents related to resolution of issues.
h. Other reports required by commissioning process.
i. List unresolved issues and reasons they remain unresolved and should be exempted from the requirements for Construction-Phase Commissioning Completion.
j. Report shall include commissioning work of Contractor.

B. Request for Certificate of Construction-Phase Commissioning Process Completion.

C. Operation and Maintenance Data: For proprietary test equipment, instrumentation, and tools to include in operation and maintenance manuals.

1.7 QUALITY ASSURANCE

A. Commissioning Coordinator Qualifications:

1. Documented experience commissioning systems of similar complexity to those contained in these documents on at least three projects of similar scope and complexity.

B. Calibration Agency Qualifications: Certified by The American Association for Laboratory Accreditation that the calibration agency complies with minimum requirements of ISO/IEC 17025.

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT, INSTRUMENTATION, AND TOOLS

A. Test equipment and instrumentation required to perform the commissioning process shall remain the property of Contractor unless otherwise indicated.

B. Test equipment and instrumentation required to perform commissioning process shall comply with the following criteria:

1. Be manufactured for the purpose of testing and measuring tests for which they are being used and have an accuracy to test and measure system performance within the tolerances required to determine acceptable performance.
2. Calibrated and certified.

    a. Calibration performed and documented by a qualified calibration agency according to national standards applicable to the tools and instrumentation being calibrated. Calibration shall be current according to national standards or within test equipment and instrumentation manufacturer's recommended intervals, whichever is more frequent, but not less than within six months of initial use on Project. Calibration tags shall be permanently affixed.
    b. Repair and recalibrate test equipment and instrumentation if dismantled, dropped, or damaged since last calibrated.

3. Maintain test equipment and instrumentation.
4. Use test equipment and instrumentation only for testing or monitoring Work for which they are designed.

2.2 PROPRIETARY TEST EQUIPMENT, INSTRUMENTATION, AND TOOLS

A. Proprietary test equipment, instrumentation, and tools are those manufactured or prescribed by tested equipment manufacturer and required for work on its equipment as a condition of equipment warranty, or as otherwise required to service, repair, adjust, calibrate, or perform work on its equipment.

1. Identify proprietary test equipment, instrumentation, and tools required in the test equipment identification list submittal.
2. Proprietary test equipment, instrumentation, and tools shall become the property of Owner at Substantial Completion.

2.3 REPORT FORMAT AND ORGANIZATION

A. General Format and Organization:

1. Record report on compact disk.
2. Electronic Data: Portable document format (PDF); a single file with outline-organized bookmarks for major and minor tabs and tab contents itemized for specific reports.

B. Commissioning Report:

1. Include a table of contents and an index to each test.
2. Include major tabs for each Specification Section.
3. Include minor tabs for each test.
4. Within each minor tab, include the following:

    a. Test specification.
    b. Pre-startup reports.
    c. Approved test procedures.

d. Test data forms, completed and signed.
e. Commissioning issue reports, showing resolution of issues, and documentation related to resolution of issues pertaining to a single test. Group data forms, commissioning issue reports showing resolution of issues, and documentation related to resolution of issues for each test repetition together within the minor tab, in reverse chronological order (most recent on top).

PART 3 - EXECUTION

3.1 PREPARATION

A. Review preliminary construction checklists and preliminary test procedures and data forms.

3.2 CONSTRUCTION CHECKLISTS

A. Construction checklists cannot modify or conflict with the Contract Documents.

B. Create construction checklists based on actual systems and equipment to be included in Project.

C. Material Checks: Compare specified characteristics and approved submittals with materials as received. Include factory tests and other evaluations, adjustments, and tests performed prior to shipment if applicable.

1. Service connection requirements, including configuration, size, location, and other pertinent characteristics.
2. Included optional features.
3. Delivery Receipt Check: Inspect and record physical condition of materials and equipment on delivery to Project site, including agreement with approved submittals, cleanliness, and lack of damage.
4. Installation Checks:

a. Location according to Drawings and approved Shop Drawings.
b. Configuration.
c. Compliance with manufacturers' written installation instructions.
d. Attachment to structure.
e. Access clearance to allow for maintenance, service, repair, removal, and replacement without the need to disassemble or remove other equipment or building elements. Access coordinated with other building elements and equipment, including, but not limited to, ceiling and wall access panels, in a manner consistent with OSHA fall-protection regulations and safe work practices.
f. Utility connections are of the correct characteristics, as applicable.
g. Correct labeling and identification.
h. Startup Checks: Verify readiness of equipment to be energized. Include manufacturer's standard startup procedures and forms.

D. Startup: Perform and document initial operation of equipment to prove that it is installed properly and operates as intended according to manufacturer's standard startup procedures, at minimum.

E. Performance Tests:

1. Static Tests: As specified elsewhere, including, but not limited to, duct and pipe leakage tests, insulation-resistance tests, and water-penetration tests.
2. Component Performance Tests: Tests evaluate the performance of an input or output of components under a full range of operating conditions.
3. Equipment and Assembly Performance Tests: Test and evaluate performance of equipment and assemblies under a full range of operating conditions and loads.
4. System Performance Tests: Test and evaluate performance of systems under a full range of operating conditions and loads.
5. Intersystem Performance Tests: Test and evaluate the interface of different systems under a full range of operating conditions and loads.

F. Deferred Construction Checklists: Obtain Owner approval of proposed deferral of construction checklists, including proposed schedule of completion of each deferred construction checklist, before submitting request for Certificate of Construction-Phase Commissioning Process Completion. When approved, deferred construction checklists may be completed after date of Construction-Phase Commissioning Completion. Include the following in a request for Certificate of Construction-Phase Commissioning Process Completion:

1. Identify deferred construction checklists by number and title.
2. Provide a target schedule for completion of deferred construction checklists.
3. Written approval of proposed deferred construction checklists, including approved schedule of completion of each deferred construction checklist.

G. Delayed Construction Checklists: Obtain Owner approval of proposed delayed construction checklists, including proposed schedule of completion of each delayed construction checklist, before submitting request for Certificate of Construction-Phase Commissioning Process Completion. When approved, delayed construction checklists may be completed after date of Construction-Phase Commissioning Completion. Include the following in a request for Certificate of Construction-Phase Commissioning Process Completion:

1. Identify delayed construction checklist by construction checklist number and title.
2. Provide a target schedule for completion of delayed construction checklists.
3. Written approval of proposed delayed construction checklists, including approved schedule of completion of each delayed construction checklist.

3.3 GENERAL EXECUTION REQUIREMENTS

A. Schedule and coordinate commissioning process with the Construction Schedule.

B. Perform activities identified in construction checklists, including tests, and document results of actions as construction proceeds.

C. Perform test demonstrations for Owner's witness. Unless otherwise indicated, demonstrate tests for 100 percent of work to which the test applies. In some instances, demonstration of a random sample of other than 100 percent of the results of a test is specified.

1. On determination of the sample size, the samples shall be selected randomly by Owner's witness at the time of the test demonstration.
2. Include in the Commissioning Plan a detailed list of the test demonstrations with lot and sample quantities for each test.

D. Report test data and commissioning issue resolutions.

E. Schedule personnel to participate in and perform Commissioning-Process Work.

F. Installing contractors' commissioning responsibilities include, but are not limited to, the following:

1. Operating the equipment and systems they install during tests.
2. In addition, installing contractors may be required to assist in tests of equipment and systems with which their work interfaces.

3.4 COMMISSIONING COORDINATOR RESPONSIBILITIES

A. Management and Coordination: Manage, schedule, and coordinate commissioning process, including, but not limited to, the following:

1. Coordinate with subcontractors on their commissioning responsibilities and activities.
2. Obtain, assemble, and submit commissioning documentation.
3. Attend periodic on-site commissioning meetings. Comply with requirements in Section 013100 "Project Management and Coordination."
4. Develop and maintain the commissioning schedule. Integrate commissioning schedule into the Construction Schedule. Update Construction Schedule at specified intervals.
5. Review and comment on preliminary test procedures and data forms.
6. Report inconsistencies and issues in system operations.
7. Verify that tests have been completed and results comply with acceptance criteria, and that equipment and systems are ready before scheduling test demonstrations.
8. Direct and coordinate test demonstrations.
9. Coordinate witnessing of test demonstrations by Owner's witness.
10. Coordinate and manage training. Be present during training sessions to direct video recording, present training, and direct the training presentations of others. Comply with requirements in Section 017900 "Demonstration and Training."
11. Prepare and submit specified commissioning reports.
12. Track commissioning issues until resolution and retesting is successfully completed.
13. Retain original records of Commissioning-Process Work, organized as required for the commissioning report. Provide Owner's representative access to these records on request.
14. Assemble and submit commissioning report.

3.5 COMMISSIONING TESTING

A. Quality Control: Construction checklists, including tests, are quality-control tools designed to improve the functional quality of Project. Test demonstrations evaluate the effectiveness of Contractor's quality-control process.

B. Owner's witness will be present to witness commissioning work requiring the signature of an owner's witness, including, but not limited to, test demonstrations. Owner's project manager will coordinate attendance by Owner's witness with Contractor's published Commissioning Schedule. Owner's witness will provide no labor or materials in the commissioning work. The only function of Owner's witness will be to observe and comment on the progress and results of commissioning process.

C. Construction Checklists:

1. Complete construction checklists as Work is completed.
2. Distribute construction checklists to installing contractors before they start work.
3. Installers:

    a. Verify installation using approved construction checklists as Work proceeds.
    b. Complete and sign construction checklists daily for work performed during the preceding day.

4. Provide Commissioning Authority access to construction checklists.

D. Installation Compliance Issues: Record as an installation compliance issue Work found to be incomplete, inaccessible, at variance with the Contract Documents, nonfunctional, or that does not comply with construction checklists. Record installation compliance issues on the construction checklist at the time they are identified. Record corrective action and how future Work should be modified before signing off the construction checklist.

E. Pre-Startup Audit: Prior to executing startup procedures, review completed installation checks to determine readiness for startup and operation. Report conditions, which, if left uncorrected, adversely impact the ability of systems or equipment to operate satisfactorily or to comply with acceptance criteria. Prepare pre-startup report for each system.

F. Test Procedures and Test Data Forms:

1. Test procedures shall define the step-by-step procedures to be used to execute tests and test demonstrations.
2. Test procedures shall be specific to the make, model, and application of the equipment and systems being tested.
3. Completed test data forms are the official records of the test results.
4. Commissioning Authority will provide to Contractor preliminary test procedures and test data forms for performance tests and commissioning tests after approval of Product Data, Shop Drawings, and preliminary operation and maintenance manual.
5. Review preliminary test procedures and test data forms, and provide comments within 14 days of receipt from Commissioning Authority. Review shall address the following:

a. Equipment protection and warranty issues, including, but not limited to, manufacturers' installation and startup recommendations, and operation and maintenance instructions.
b. Applicability of the procedure to the specific software, equipment, and systems approved for installation.

6. After Contractor has reviewed and commented on the preliminary test procedures and test data forms, Commissioning Authority will revise and reissue the approved revised test procedures and test data forms marked "Approved for Testing."
7. Use only approved test procedures and test data forms marked "Approved for Testing" to perform and document tests and test demonstrations.

G. Performance of Tests:

1. The sampling rate for tests is 100 percent. The sampling rate for test demonstrations is 100 percent unless otherwise indicated.
2. Perform and complete each step of the approved test procedures in the order listed.
3. Record data observed during performance of tests on approved data forms at the time of test performance and when the results are observed.
4. Record test results that are not within the range of acceptable results on commissioning issue report forms in addition to recording the results on approved test procedures and data forms according to the "Commissioning Compliance Issues" Paragraph in this Article.
5. On completion of a test, sign the completed test procedure and data form. Tests for which test procedures and data forms are incomplete, not signed, or which indicate performance that does not comply with acceptance criteria will be rejected. Tests for which test procedures and data forms are rejected shall be repeated and results resubmitted.

H. Performance of Test Demonstration:

1. Perform test demonstrations on a sample of tests after test data submittals are approved. The sampling rate for test demonstrations shall be 100 percent unless otherwise indicated in the individual test specification.
2. Notify Owner's witness at least three days in advance of each test demonstration.
3. Perform and complete each step of the approved test procedures in the order listed.
4. Record data observed during performance of test demonstrations on approved data forms at the time of demonstration and when the results are observed.
5. Provide full access to Owner's witness to directly observe the performance of all aspects of system response during the test demonstration. On completion of a test demonstration, sign the completed data form and obtain signature of Owner's witness at the time of the test to authenticate the reported results.
6. Test demonstration data forms not signed by Contractor and Owner's witness at the time of the completion of the procedure will be rejected. Test demonstrations for which data forms are rejected shall be repeated and results shall be resubmitted.

a. Exception for Failure of Owner's Witness to Attend: Failure of Owner's witness to be present for agreed-on schedule of test demonstration shall not delay Contractor. If Owner's witness fails to attend a scheduled test, Contractor shall proceed with the scheduled test. On completion, Contractor shall sign the data form for

Contractor and for Owner's witness, and shall note the absence of Owner's witness at the scheduled time and place.

7. False load test requirements are specified in related sections.

    a. Where false load testing is specified, provide temporary equipment, power, controls, wiring, piping, valves, and other necessary equipment and connections required to apply the specified load to the system. False load system shall be capable of steady-state operation and modulation at the level of load specified. Equipment and systems permanently installed in this work shall not be used to create the false load without Architect's written approval.

I. Deferred Tests:

1. Deferred Test List: Identify, in the request for Certificate of Construction-Phase Commissioning Process Completion, proposed deferred tests or other tests approved for deferral until specified seasonal or other conditions are available. When approved, deferred tests may be completed after the date of Construction-Phase Commissioning Completion. Identify proposed deferred tests in the request for Certificate of Construction-Phase Commissioning Process Completion as follows:

    a. Identify deferred tests by number and title.
    b. Provide a target schedule for completion of deferred tests.

2. Schedule and coordinate deferred tests. Schedule deferred tests when specified conditions are available. Notify Architect and Commissioning Authority at least three working days (minimum) in advance of tests.
3. Where deferred tests are specified, coordinate participation of necessary personnel and of Architect, Commissioning Authority, and Owner's witness. Schedule deferred tests to minimize occupant and facility impact. Obtain Architect's approval of the proposed schedule.

J. Delayed Tests:

1. Delayed Test List: Identify, in the request for Certificate of Construction-Phase Commissioning Process Completion, proposed delayed tests. Obtain Owner approval of proposed delayed tests, including proposed schedule of completion of each delayed test, before submitting request for Certificate of Construction-Phase Commissioning Process Completion. Include the following in the request for Certificate of Construction-Phase Commissioning Process Completion:

    a. Identify delayed tests by test number and title.
    b. Written approval of proposed delayed tests, including approved schedule of completion of delayed tests.

2. Schedule and coordinate delayed tests. Schedule delayed tests when conditions that caused the delay have been rectified. Notify Architect and Commissioning Authority at least three working days (minimum) in advance of tests.
3. Where delayed tests are approved, coordinate participation of necessary personnel and of Architect, Commissioning Authority, and Owner's witness. Schedule delayed tests to

minimize occupant and facility impact. Obtain Architect's approval of the proposed schedule.

K. Commissioning Compliance Issues:

1. Test results that are not within the range of acceptable results are commissioning compliance issues.
2. Track and report commissioning compliance issues until resolution and retesting are successfully completed.
3. If a test demonstration fails, determine the cause of failure. Direct timely resolution of issue and then repeat the demonstration. If a test demonstration must be repeated due to failure caused by Contractor work or materials, reimburse Owner for billed costs for the participation in the repeated demonstration.
4. Test Results: If a test demonstration fails to meet the acceptance criteria, perform the following:

    a. Complete a commissioning compliance issue report form promptly on discovery of test results that do not comply with acceptance criteria.
    b. Submit commissioning compliance issue report form within 24 hours of the test.
    c. Determine the cause of the failure.
    d. Establish responsibility for corrective action if the failure is due to conditions found to be Contractor's responsibility.

5. Commissioning Compliance Issue Report: Provide a commissioning compliance issue report for each issue. Do not report multiple issues on the same commissioning compliance issue report.

    a. Exception: If an entire class of devices is determined to exhibit the identical issue, they may be reported on a single commissioning compliance issue report. (For example, if all return-air damper actuators that are specified to fail to the open position are found to fail to the closed position, they may be reported on a single commissioning issue report. If a single commissioning issue report is used for multiple commissioning compliance issues, each device shall be identified in the report, and the total number of devices at issue shall be identified.
    b. Complete and submit Part 1 of the commissioning compliance issue report immediately when the condition is observed.
    c. Record the commissioning compliance issue report number and describe the deficient condition on the data form.
    d. Resolve commissioning compliance issues promptly. Complete and submit Part 2 of the commissioning compliance issue report when issues are resolved.

6. Diagnose and correct failed test demonstrations as follows:

    a. Perform diagnostic tests and activities required to determine the fundamental cause of issues observed.
    b. Record each step of the diagnostic procedure prior to performing the procedure. Update written procedure as changes become necessary.
    c. Record the results of each step of the diagnostic procedure.
    d. Record the conclusion of the diagnostic procedure on the fundamental cause of the issue.

e. Determine and record corrective measures.
f. Include diagnosis of fundamental cause of issues in commissioning compliance issue report.

7. Retest:

a. Schedule and repeat the complete test procedure for each test demonstration for which acceptable results are not achieved. Obtain signature of Owner's witness on retest data forms. Repeat test demonstration until acceptable results are achieved. Except for issues that are determined to result from design errors or omissions, or other conditions beyond Contractor's responsibility, compensate Owner for direct costs incurred as the result of repeated test demonstrations to achieve acceptable results.
b. For each repeated test demonstration, submit a new test data form, marked "Retest."

8. Do not correct commissioning compliance issues during test demonstrations.

a. Exceptions will be allowed if the cause of the issue is obvious and resolution can be completed in less than five minutes. If corrections are made under this exception, note the deficient conditions on the test data form and issue a commissioning compliance issue report. A new test data form, marked "Retest," shall be initiated after the resolution has been completed.

3.6 COMMISSIONING MEETINGS

A. Commissioning Authority will schedule and conduct commissioning meetings. Comply with requirements in Section 013100 "Project Management and Coordination."

3.7 SEQUENCING

A. Sequencing of Commissioning Verification Activities: For a particular material, item of equipment, assembly, or system, perform the following in the order listed unless otherwise indicated:

1. Construction Checklists:

a. Material checks.
b. Installation checks.
c. Startup, as appropriate. Some startup may depend on component performance. Such startup may follow component performance tests on which the startup depends.
d. Performance Tests:

1) Static tests, as appropriate.
2) Component performance tests. Some component performance tests may depend on completion of startup. Such component performance tests may follow startup.

3) Equipment and assembly performance tests.
4) System performance tests.
5) Intersystem performance tests.

2. Commissioning tests.

B. Before performing commissioning tests, verify that materials, equipment, assemblies, and systems are delivered, installed, started, and adjusted to perform according to construction checklists.

C. Verify readiness of materials, equipment, assemblies, and systems by performing tests prior to performing test demonstrations. Notify Architect if acceptable results cannot be achieved due to conditions beyond Contractor's control or responsibility.

D. Commence tests as soon as installation checks for materials, equipment, assemblies, or systems are satisfactorily completed. Tests of a particular system may proceed prior to completion of other systems, provided the incomplete work does not interfere with successful execution of test.

3.8 SCHEDULING

A. Commence commissioning process as early in the construction period as possible.

B. Commissioning Schedule: Integrate commissioning activities into Construction Schedule. See Section 013200 "Construction Progress Documentation."

1. Include detailed commissioning activities in monthly updated Construction Schedule and short-interval schedule submittals.
2. Schedule the start date and duration for the following commissioning activities:

a. Submittals.
b. Preliminary operation and maintenance manual submittals.
c. Installation checks.
d. Startup, where required.
e. Performance tests.
f. Performance test demonstrations.
g. Commissioning tests.
h. Commissioning test demonstrations.

3. Schedule shall include a line item for each installation check, startup, and test activity specific to the equipment or systems involved.
4. Determine milestones and prerequisites for commissioning process. Show commissioning milestones, prerequisites, and dependencies in monthly updated critical-path-method construction schedule and short-interval schedule submittals.

C. Two-Week Look-Ahead Commissioning Schedule:

1. Two weeks prior to the beginning of tests, submit a detailed two-week look-ahead schedule. Thereafter, submit updated two-week look-ahead schedules weekly for the duration of commissioning process.
2. Two-week look-ahead schedules shall identify the date, time, beginning location, Contractor personnel required, and anticipated duration for each startup or test activity.
3. Use two-week look-ahead schedules to notify and coordinate participation of Owner's witnesses.

D. Owner's Witness Coordination:

1. Coordinate Owner's witness participation via Architect.
2. Notify Architect of commissioning schedule changes at least two work days in advance for activities requiring the participation of Owner's witness.

3.9 COMMISSIONING REPORTS

A. Test Reports:

1. Pre-startup reports include observations of the conditions of installation, organized into the following sections:

   a. Equipment Model Verification: Compare contract requirements, approved submittals, and provided equipment. Note inconsistencies.
   b. Preinstallation Physical Condition Checks: Observe physical condition of equipment prior to installation. Note conditions including, but not limited to, physical damage, corrosion, water damage, or other contamination or dirt.
   c. Preinstallation Component Verification Checks: Verify components supplied with the equipment, preinstalled or field installed, are correctly installed and functional. Verify external components required for proper operation of equipment correctly installed and functional. Note missing, improperly configured, improperly installed, or nonfunctional components.
   d. Summary of Installation Compliance Issues and Corrective Actions: Identify installation compliance issues and the corrective actions for each. Verify that issues noted have been corrected.
   e. Evaluation of System Readiness for Startup: For each item of equipment for each system for which startup is anticipated, document in summary form acceptable to Owner completion of equipment model verification, preinstallation physical condition checks, preinstallation component verification checks, and completion of corrective actions for installation compliance issues.

2. Test data reports include the following:

   a. "As-tested" system configuration. Complete record of conditions under which the test was performed, including, but not limited to, the status of equipment, systems, and assemblies; temporary adjustments and settings; and ambient conditions.
   b. Data and observations, including, but not limited to, data trend logs, recorded during the tests.
   c. Signatures of individuals performing and witnessing tests.
   d. Data trend logs accumulated overnight from the previous day of testing.

3. Commissioning Compliance Issue Reports: Report as commissioning compliance issues results of tests and test demonstrations that do not comply with acceptance criteria. Report only one issue per commissioning compliance issue report. Use sequentially numbered facsimiles of commissioning compliance issue report form included in this Section, or other form approved by Owner. Distribute commissioning compliance issue reports to parties responsible for taking corrective action. Identify the following:

    a. Commissioning compliance issue report number. Assign unique, sequential numbers to individual commissioning compliance issue reports when they are created, to be used for tracking.
    b. Action distribution list.
    c. Report date.
    d. Test number and description.
    e. Equipment identification and location.
    f. Briefly describe observations about the performance associated with failure to achieve acceptable results. Identify the cause of failure if apparent.
    g. Diagnostic procedure or plan to determine the cause (include in initial submittal)
    h. Diagnosis of fundamental cause of issues as specified below (include in resubmittal).
    i. Fundamental cause of unacceptable performance as determined by diagnostic tests and activities.
    j. When issues have been resolved, update and resubmit the commissioning issue report forms by completing Part 2. Identify resolution taken and the dates and initials of the persons making the entries.
    k. Schedule for retesting.

4. Weekly progress reports include information for tests conducted since the preceding report and the following:

    a. Completed data forms.
    b. Equipment or system tested, including test number, system or equipment tag number and location, and notation about the apparent acceptability of results.
    c. Activities scheduled but not conducted per schedule.
    d. Commissioning compliance issue report log.
    e. Schedule changes for remaining Commissioning-Process Work, if any.

5. Data trend logs shall be initiated and running prior to the time scheduled for the test demonstration.

    a. Trend log data format shall be multiple data series graphs. Where multiple data series are trend logged concurrently, present the data on a common horizontal time axis. Individual data series may be presented on a segmented vertical axis to avoid interference of one data series with another, and to accommodate different axis scale values. Graphs shall be sufficiently clear to interpret data within the accuracy required by the acceptance criteria.
    b. Attach to the data form printed trend log data collected during the test or test demonstration.
    c. Record, print out, and attach to the data form operator activity during the time the trend log is running. During the time the trend log is running, operator intervention not directed by the test procedure invalidates the test results.

6. System Alarm Logs: Record and print out a log of alarms that occurred since the last log was printed. Evaluate alarms to determine if the previous day's work resulted in any conditions that are not considered "normal operation."

    a. Conditions that are not considered "normal operation" shall be reported on a commissioning issue report attached to the alarm log. Resolve as necessary. The intent of this requirement is to discover control system points or sequences left in manual or disabled conditions, equipment left disconnected, set points left with abnormal values, or similar conditions that may have resulted from failure to fully restore systems to normal, automatic control after test completion.

3.10 CERTIFICATE OF CONSTRUCTION-PHASE COMMISSIONING PROCESS COMPLETION

A. When Contractor considers that construction-phase commissioning process, or a portion thereof which Owner agrees to accept separately, is complete, Contractor shall prepare and submit to Owner and Commissioning Authority through Architect a comprehensive list of items to be completed or corrected. Failure to include an item on such list does not alter Contractor's responsibility to compete commissioning process.

B. On receipt of Contractor's list, Commissioning Authority will make an inspection to determine whether the construction-phase commissioning process or designated portion thereof is complete. If Commissioning Authority's inspection discloses items, whether included on Contractor's list, which is not sufficiently complete as defined in "Construction-Phase Commissioning Process Completion" Paragraph in the "Definitions" Article, Contractor shall, before issuance of the Certificate of Construction-Phase Commissioning Process Completion, complete or correct such items on notification by Commissioning Authority. In such case, Contractor shall then submit a request for another inspection by Commissioning Authority to determine construction-phase commissioning process completion.

C. Contractor shall promptly correct deficient conditions and issues discovered during commissioning process. Costs of correcting such deficient conditions and issues, including additional testing and inspections, the cost of uncovering and replacement, and compensation for Architect's and Commissioning Authority's services and expenses made necessary thereby, shall be at Contractor's expense.

D. When construction-phase commissioning process or designated portion is complete, Commissioning Authority will prepare a Certificate of Construction-Phase Commissioning Process Completion that shall establish the date of completion of construction-phase commissioning process. Certificate of Construction-Phase Commissioning Process Completion shall be submitted prior to requesting inspection for determining date of Substantial Completion.

END OF SECTION 019113

SECTION 024119 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. The Work of this Section Includes:

1. Demolition and removal of selected portions of exterior or interior of building or structure.
2. Removal and salvage of existing items for delivery to Owner.

B. Related Requirements:

1. Section 011000 "Summary" for restrictions on use of the premises, Owner-occupancy requirements, and phasing requirements.
2. Section 015639 "Temporary Tree and Plant Protection" for temporary protection of existing trees and plants that are affected by selective demolition.
3. Section 017300 "Execution" for cutting and patching procedures.
4. Section 024119.11 “Selective Demolition – Site Elements” for demolition of site elements.
5. Section 311000 "Site Clearing" for site clearing and removal of above- and below-grade improvements not part of selective demolition.
6. Section 330500 "Common Work Results for Utilities" for removal of site utility systems piping, equipment, and components.

1.2 DEFINITIONS

A. Remove: Detach items from existing construction and legally dispose of off-site unless indicated to be removed and salvaged or removed and reinstalled.

B. Remove and Salvage: Detach items from existing construction, in a manner to prevent damage, and deliver to Owner as indicated.

C. Remove and Reinstall: Detach items from existing construction, in a manner to prevent damage; prepare for reuse; and reinstall where indicated.

D. Existing to Remain: Existing items of construction that are not to be removed.

1.3 MATERIALS OWNERSHIP

A. Unless otherwise indicated, demolition waste becomes property of Contractor.

B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.

1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.4 COORDINATION

A. Arrange selective demolition schedule so as not to interfere with Owner's operations.

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 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.
6. Review and finalize protection requirements.
7. Review procedures for noise control and dust control.
8. Review storage, protection, and accounting for items to be removed for salvage or reinstallation.

1.6 INFORMATIONAL SUBMITTALS

A. 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 on-site operations are uninterrupted.
2. Temporary interruption of utility services. Indicate how long utility services will be interrupted.
3. Coordination for shutoff, capping, and continuation of utility services.
4. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.

B. Warranties: Documentation indicating 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.

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.

C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

D. Hazardous Materials:

1. It is not expected that hazardous materials will be encountered in the Work.

a. Hazardous materials will be removed by Owner before start of the Work.
b. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.

E. On-site sale of removed items or materials is not permitted.

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 and using approved contractors so as not to void existing warranties. Notify warrantor before proceeding. Existing warranties include the following:

1. Roofing. Verify with the Owner.

B. Notify warrantor on completion of selective demolition, and obtain documentation verifying that existing system has been inspected and warranty remains in effect. Submit documentation at Project closeout.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

B. Standards: Comply with ANSI/ASSP A10.6 and NFPA 241.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped before starting selective demolition operations.

B. Survey of Existing Conditions: Record existing conditions by use of preconstruction photographs or video. Comply with Section 013233 "Photographic Documentation."

1. Inventory and record the condition of items to be removed for salvage or reinstallation. Photograph or video conditions that might be misconstrued as damage caused by removal.
2. Photograph or video existing conditions of adjoining construction including finish surfaces, that might be misconstrued as damage caused by selective demolition operations or removal of items for salvage or reinstallation.

3.2 PREPARATION

A. Temporary Protection: 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."

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 and cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.3 UTILITY SERVICES AND BUILDING SYSTEMS

A. Existing Services/Systems to Remain: Maintain utilities and building systems and equipment to remain and protect against damage during selective demolition operations.

1. Maintain fire-protection facilities in service during selective demolition operations.

B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off utilities and building systems serving areas to be selectively demolished.

1. Arrange to shut off utilities with utility companies.
2. If disconnection of utilities and building systems will affect adjacent occupied parts of the building, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to those parts of the building.
3. Demolish and remove existing building systems, equipment, and components indicated on Drawings to be removed.

    a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
    b. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
    c. Equipment to Be Removed: Disconnect and cap services and remove equipment and components.

4. Abandon existing building systems, equipment, and components indicated on Drawings to be abandoned in place.

    a. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material and leave in place.
    b. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material and leave in place.

5. Remove and reinstall/salvage existing building systems, equipment, and components indicated on drawings to be removed and reinstalled or removed and salvaged:

    a. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment and components; when appropriate, reinstall, reconnect, and make equipment operational.
    b. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and components and deliver to Owner.

3.4 SALVAGE/REINSTALL

A. Removed and Salvaged Items:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers with label indicating elements, date of removal, quantity, and location where removed.
3. Store items in a secure area until delivery to Owner.
4. Transport items to Owner's storage area on-site, designated by Owner.
5. Protect items from damage during transport and storage.

3.5 SELECTIVE DEMOLITION, GENERAL

A. General: Demolish and remove existing construction only to 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. Temporarily cover openings to remain.
3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
5. Maintain fire watch during and for at least two hours after flame-cutting operations.
6. Maintain adequate ventilation when using cutting torches.
7. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
8. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
9. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.

3.6 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

A. Concrete:

1. 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.
2. Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals using power-driven saw, and then remove concrete between saw cuts.

B. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, and 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.

D. Roofing: Remove no more existing roofing than what can be covered in one day by new roofing and so that building interior remains watertight and weathertight. See Section 075423 "Thermoplastic-Polyolefin (TPO) Roofing" for new roofing requirements.

1. Remove existing roof membrane, flashings, copings, and roof accessories.

3.7 DISPOSAL OF DEMOLISHED MATERIALS

A. Remove demolition waste materials from Project site and recycle or dispose of them in accordance with Section 017419 "Construction Waste Management and Disposal."

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.
4. Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."

B. Burning: Do not burn demolished materials.

3.8 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 024119

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SECTION 024119 - SELECTIVE DEMOLITION – SITE ELEMENTS

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 015639 "Temporary Tree and Plant Protection" for temporary protection of existing trees and plants that are affected by selective demolition.
2. Section 311000 "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 for reuse.

C. Remove and Reinstall: Detach items from existing construction, prepare for reuse, and reinstall where indicated.

D. Existing to Remain: Existing items of construction that are not to be permanently removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.4 MATERIALS OWNERSHIP

A. Unless otherwise indicated, demolition waste becomes property of Contractor.

B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.

1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.5 PREINSTALLATION MEETINGS

A. Pre-demolition Conference: Conduct conference at Project site.

1. Inspect and discuss condition of construction to be selectively demolished.
2. Review structural load limitations of existing structure.
3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
5. Review areas where existing construction is to remain and requires protection.
6. If needed, insert list of conference participants not mentioned in Section 013100 "Project Management and Coordination."

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For refrigerant recovery technician.

B. 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.

C. 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.
4. Use of elevator and stairs.
5. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.

D. Inventory: Submit a list of items to be removed and salvaged and deliver to Owner prior to start of demolition.

E. Pre-demolition Photographs or Video: Submit before Work begins.

F. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.

G. 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 QUALITY ASSURANCE

A. Refrigerant Recovery Technician Qualifications: Certified by an EPA-approved certification program.

1.9 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.

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. Hazardous Materials: Hazardous materials are present in buildings and structures to be selectively demolished. A report on the presence of hazardous materials is on file for review and use. Examine report to become aware of locations where hazardous materials are present.

1. Hazardous material remediation is specified elsewhere in the Contract Documents.
2. Do not disturb hazardous materials or items suspected of containing hazardous materials except under procedures specified elsewhere in the Contract Documents.
3. Retain subparagraph below if hazardous materials are known to be present. Delete if Owner does not have, or will not provide, material safety data sheets for these materials.
4. Owner will provide material safety data sheets for suspected hazardous materials that are known to be present in buildings and structures to be selectively demolished because of building operations or processes performed there.

F. Historic Areas: Demolition and hauling equipment and other materials shall be of sizes that clear surfaces within historic spaces, areas, rooms, and openings, including temporary protection, by 12 inches or more.

G. Storage or sale of removed items or materials on-site is not permitted.

H. 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.

1.10 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.

B. Notify warrantor on completion of selective demolition, and obtain documentation verifying that existing system has been inspected and warranty remains in effect. Submit documentation at Project closeout.

PART 2 - PRODUCTS

2.1 PEFORMANCE 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 3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped before starting selective demolition operations.

B. Review record documents of existing construction provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in record documents.

C. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.

D. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Architect.

E. Engage a professional engineer to perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective building demolition operations.

1. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.
2. Steel Tendons: Locate tensioned steel tendons and include recommendations for de-tensioning.

F. Survey of Existing Conditions: Record existing conditions by use of measured drawings and preconstruction photographs.

1. Comply with requirements specified in Section 013233 "Photographic Documentation."
2. Inventory and record the condition of items to be removed and salvaged. Provide photographs or video of conditions that might be misconstrued as damage caused by salvage operations.
3. Before selective demolition or removal of existing building elements that will be reproduced or duplicated in final Work, make permanent record of measurements, materials, and construction details required to make exact reproduction.

3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.

1. Comply with requirements for existing services/systems interruptions specified in Section 011000 "Summary."

B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.

1. Owner will arrange to shut off indicated services/systems when requested by Contractor.
2. Arrange to shut off indicated utilities with utility companies.
3. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
4. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated to be removed.

    a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
    b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
    c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
    d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
    e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
    f. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.

g. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.

C. Refrigerant: Remove refrigerant from mechanical equipment to be selectively demolished according to 40 CFR 82 and regulations of authorities having jurisdiction.

3.3 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.

1. Comply with requirements for access and protection specified in Section 015000 "Temporary Facilities and Controls."

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.

3.4 SELECTIVE DEMOLITION – SITE ELEMENTS, 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 comply with requirements in Section 017419 "Construction Waste Management and Disposal.

B. Work in Historic Areas: Selective demolition may be performed only in areas of the Project that are not designated as historic. In historic spaces, areas, and rooms or on historic surfaces, the terms "demolish" or "remove" shall mean historic "removal" or "dismantling" as specified in Section 013591 "Historic Treatment Procedures."

C. Removed and Salvaged Items:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in a secure area until delivery to Owner.
4. Transport items to Owner's storage area designated by Owner.
5. Protect items from damage during transport and storage.

D. Removed and Reinstalled Items:

1. Clean and repair items to functional condition adequate for intended reuse.
2. Pack or crate items after cleaning and repairing. Identify contents of containers.
3. Protect items from damage during transport and storage.
4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

E. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.5 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. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals using power-driven saw, then remove concrete between saw cuts.

C. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, then remove masonry between saw cuts.

D. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, then break up and remove.

E. Resilient Floor Coverings: Remove floor coverings and adhesive according to recommendations in RFCI's "Recommended Work Practices for the Removal of Resilient Floor Coverings. Do not use methods requiring solvent-based adhesive strippers.

F. Roofing: Remove no more existing roofing than what can be covered in one day by new roofing and so that building interior remains watertight and weathertight.

1. Remove existing roof membrane, flashings, copings, and roof accessories.
2. Remove existing roofing system down to substrate.

3.6 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.

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. Coordinate first subparagraph below with use of elevators, stairs, or building entries permitted by building manager.
4. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
5. Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."

B. Burning: Do not burn demolished materials.

C. Burning: Burning of demolished materials will be permitted only at designated areas on Owner's property, provided required permits are obtained. Provide full-time monitoring for burning materials until fires are extinguished.

D. Disposal: Transport demolished materials and dispose of at designated spoil areas on Owner's property.

E. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

3.7 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.

3.8 SELECTIVE DEMOLITION – SITE ELEMENTS SCHEDULE

A. Existing Items to Be Removed: See construction drawings.

B. Existing Items to Be Removed and Salvaged: See construction drawings.

C. Existing Items to Be Removed and Reinstalled: See construction drawings.

D. "Existing Items to Remain" Paragraph below may be used to inform Contractor of items that are to remain, such as those that occur in, or are adjacent to, construction being demolished, but are not being removed and reinstalled. Retain paragraph if required.

E. Existing Items to Remain: See construction drawings.

END OF SECTION 024119

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SECTION 031000 – 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 other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes

1. Formwork for cast-in place concrete, with shoring, bracing and anchorage.
2. Openings for other work.
3. Form accessories.
4. Form stripping.

1.3 RELATED REQUIREMENTS

A. Section 032000 - Concrete Reinforcing.

B. Section 033000 - Cast-in-Place Concrete.

C. Section 042001 - Masonry Veneer: Spacing for veneer anchor reglets recessed in concrete.

D. Section 051200 - Structural Steel: Placement of embedded steel anchors and plates in cast-in-place concrete.

1.4 REFERENCE STANDARDS

A. ACI 117 - Standard Specifications for Tolerances for Concrete Construction and Materials; 2010 (Reapproved 2015).

B. ACI 301 - Specifications for Structural Concrete; 2016.

C. ACI 318 - Building Code Requirements for Structural Concrete and Commentary; 2014 (Errata 2018).

D. ACI 347R - Guide to Formwork for Concrete; 2014.

E. PS 1 - Structural Plywood; 2009.

1.5 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

PART 2 - PRODUCTS

2.1 FORMWORK – GENERAL

A. Provide concrete forms, accessories, shoring, and bracing as required to accomplish cast-in-place concrete work.

B. Design and construct concrete that complies with design with respect to shape, lines, and dimensions.

C. Comply with applicable state and local codes with respect to design, fabrication, erection, and removal of formwork.

D. Comply with relevant portions of ACI 347R, ACI 301, and ACI 318.

2.2 WOOD FORM MATERIALS

A. Softwood Plywood: PS 1, B-B High Density Concrete Form Overlay, Class I.

2.3 FORMWORK ACCESSORIES

A. Form Ties: Removable type, galvanized metal, fixed length, cone type, with waterproofing washer, free of defects that could leave holes larger than 1 inch in concrete surface.

B. Form Release Agent: Capable of releasing forms from hardened concrete without staining or discoloring concrete or forming bugholes and other surface defects, compatible with concrete and form materials, and not requiring removal for satisfactory bonding of coatings to be applied.

1. Composition: Colorless, reactive, water-based or solvent-based compound.
2. Do not use materials containing diesel oil or petroleum-based compounds.
3. Products:

a. SpecChem, LLC; Bio Strip WB (water-based): www.specchemllc.com/#sle.
b. W. R. Meadows, Inc; Duogard: www.wrmeadows.com/#sle.
c. Substitutions: See Section 016000 - Product Requirements.

C. Dowel Sleeves: Plastic sleeve and nailable plastic base for smooth, round, steel load-transfer dowels.

1. Products:

a. BoMetals, Inc: www.bometals.com/#sle.
b. Substitutions: See Section 016000 - Product Requirements.

D. Dovetail Anchor Slot: Galvanized steel, at least 22 gage, 0.0299 inch thick, foam filled, release tape sealed slots, anchors for securing to concrete formwork.

E. Embedded Anchor Shapes, Plates, Angles and Bars: As specified in Section 051200.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify lines, levels and centers before proceeding with formwork. Ensure that dimensions agree with drawings.

3.2 EARTH FORMS

A. Earth forms with neat consistent edges are acceptable at foundation elements unless specified otherwise in geotechnical report.

3.3 ERECTION – FORMWORK

A. Erect formwork, shoring and bracing to achieve design requirements, in accordance with requirements of ACI 301.

B. Provide bracing to ensure stability of formwork. Shore or strengthen formwork subject to overstressing by construction loads.

3.4 APPLICATION – FORM RELEASE AGENT

A. Apply form release agent on formwork in accordance with manufacturer's recommendations.

B. Apply prior to placement of reinforcing steel, anchoring devices, and embedded items.

C. Do not apply form release agent where concrete surfaces will receive special finishes or applied coverings that are affected by agent. Soak inside surfaces of untreated forms with clean water. Keep surfaces coated prior to placement of concrete.

3.5 INSERTS, EMBEDDED PARTS, AND OPENINGS

A. Provide formed openings where required for items to be embedded in passing through concrete work.

B. Locate and set in place items that will be cast directly into concrete.

C. Coordinate with work of other sections in forming and placing openings, slots, reglets, recesses, sleeves, bolts, anchors, other inserts, and components of other work.

D. Position recessed anchor slots for brick veneer masonry anchors to spacing and intervals specified in Section 042001.

E. Install accessories in accordance with manufacturer's instructions, so they are straight, level, and plumb. Ensure items are not disturbed during concrete placement.

F. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection. Locate openings at bottom of forms to allow flushing water to drain.

G. Close temporary openings with tight fitting panels, flush with inside face of forms, and neatly fitted so joints will not be apparent in exposed concrete surfaces.

3.6 FORM CLEANING

A. Clean forms as erection proceeds, to remove foreign matter within forms.

B. Clean and protect permanent insulated concrete foam panel formwork per manufacturer's recommendations.

C. Clean formed cavities of debris prior to placing concrete.

1. Flush with water or use compressed air to remove remaining foreign matter. Ensure that water and debris drain to exterior through clean-out ports.
2. During cold weather, remove ice and snow from within forms. Do not use de-icing salts. Do not use water to clean out forms, unless formwork and concrete construction proceed within heated enclosure. Use compressed air or other means to remove foreign matter.

3.7 FORMWORK TOLERANCES

A. Construct formwork to maintain tolerances required by ACI 117, unless otherwise indicated.

B. Camber slabs and beams 1/4 inch per 10 feet.

3.8 FIELD QUALITY CONTROL

A. An independent testing agency will perform field quality control tests, as specified in Section 014000 - Quality Requirements.

B. Inspect erected formwork, shoring, and bracing to ensure that work is in accordance with formwork design, and to verify that supports, fastenings, wedges, ties, and items are secure.

3.9

A. Do not remove forms or bracing until concrete has gained sufficient strength to carry its own weight and imposed loads.

B. Loosen forms carefully. Do not wedge pry bars, hammers, or tools against finish concrete surfaces scheduled for exposure to view.

END OF SECTION 031000

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SECTION 032000 – CONCRETE REINFORCING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes

1. Reinforcing steel for cast-in-place concrete.
2. Supports and accessories for steel reinforcement.

1.3 RELATED REQUIREMENTS

A. Section 031000 - Concrete Forming and Accessories.

B. Section 033000 - Cast-in-Place Concrete.

C. Section 042000 - Unit Masonry: Reinforcement for masonry.

D. Division 26 or Section 260526 - Grounding and Bonding for Electrical Systems: Grounding connection to concrete reinforcement.

1.4 REFERENCE STANDARDS

A. ACI 301 - Specifications for Structural Concrete; 2016.

B. ACI SP-66 - ACI Detailing Manual; 2004.

C. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2018, with Editorial Revision (2018).

D. ASTM A704/A704M - Standard Specification for Welded Steel Plain Bar or Rod Mats for Concrete Reinforcement; 2018.

E. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete; 2018.

F. CRSI (DA4) - Manual of Standard Practice; 2009.

1.5 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Shop Drawings: Comply with requirements of ACI SP-66. Include bar schedules, shapes of bent bars, spacing of bars, and location of splices.

1. Prepare shop drawings under seal of a Professional Structural Engineer experienced in design of work of this type and licensed in the State in which the Project is located.

C. Manufacturer's Certificate: Certify that reinforcing steel and accessories supplied for this project meet or exceed specified requirements.

D. Reports: Submit certified copies of mill test report of reinforcement materials analysis.

1.6 QUALITY ASSURANCE

A. Perform work of this section in accordance with ACI 301.

1. Maintain one copy of each document on project site.

B. Provide Architect with access to fabrication plant to facilitate inspection of reinforcement. Provide notification of commencement and duration of shop fabrication in sufficient time to allow inspection.

C. Welders' Certificates: Submit certifications for welders employed on the project, verifying AWS qualification within the previous 12 months.

PART 2 - PRODUCTS

2.1 REINFORCEMENT

A. Reinforcing Steel: ASTM A615/A615M, Grade 60 (60,000 psi).

1. Deformed billet-steel bars.
2. Unfinished.

B. Reinforcing Steel Mat: ASTM A704/A704M, using ASTM A615/A615M, Grade 60 (60,000 psi) steel bars or rods, unfinished.

C. Stirrup Steel: ASTM A1064/A1064M steel wire, unfinished.

D. Steel Welded Wire Reinforcement (WWR): Plain type; ASTM A1064/A1064M.

1. Form: Flat Sheets.
2. WWR Style: As indicated on drawings.

E. Reinforcement Accessories:

1. Tie Wire: Annealed, minimum 16 gage, 0.0508 inch.
2. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for adequate support of reinforcement during concrete placement.

    a. Manufacturers:

        1) W.H.C. Products, Inc.; Series "B".
        2) Axtec Concrete Accessories, Inc.; Type E-Z with sand plate.
        3) Shepler's; SBP-Sllab Bolster with Plate, or CHCP Continuous High Chair.

2.2 RE-BAR SPLICING:

A. Coupler Systems: Mechanical devices for splicing reinforcing bars; capable of developing full steel reinforcing design strength in tension and compression.

1. Products:

    a. Dayton Superior Corporation; Bar Lock Coupler System: www.daytonsuperior.com
    b. Substitutions: See Section 016000 - Product Requirements.

B. Dowel Bar Splicer with Dowel-Ins: Mechanical devices for connecting dowels; capable of developing full steel reinforcing design strength in tension and compression.

1. Products:

    a. Dayton Superior Corporation; Dowel Bar Splicer D101A with Straight Dowel-In: www.daytonsuperior.com
    b. Substitutions: See Section 016000 - Product Requirements.

C. Taper Tie Hole Plug: Mechanical device for plugging tie holes; anchors optional flush or recessed grout.

1. Products:

    a. Dayton Superior Corporation; A58 Sure Plug: www.daytonsuperior.com
    b. Substitutions: See Section 016000 - Product Requirements.

D. Grout: Cementitious, non-metallic, non-shrink grout for use with manufacturer's grout sleeve reinforcing bar coupler system.

1. Products:

    a. Dayton Superior Corporation; Sleeve-Lock Grout: www.daytonsuperior.com
    b. Substitutions: See Section 016000 - Product Requirements.

2.3 FABRICATION

A. Fabricate concrete reinforcing in accordance with CRSI (DA4) - Manual of Standard Practice.

B. Welding of reinforcement is not permitted.

C. Locate reinforcing splices not indicated on drawings at point of minimum stress.

1. Review locations of splices with Architect.

PART 3 - EXECUTION

3.1 PLACEMENT

A. Place, support and secure reinforcement against displacement. Do not deviate from required position.

B. Do not displace or damage vapor barrier.

C. Accommodate placement of formed openings.

D. Maintain concrete cover around reinforcing as indicated on structural drawings.

1. Beams: See structural Drawings
2. Supported Slabs and Joists: See structural Drawings.
3. Column Ties: 2 inch.
4. Walls (exposed to weather or backfill): 3 inch.
5. Footings and Concrete Formed Against Earth: 3 inch.
6. Slabs on Fill: See structural drawings.

E. Comply with applicable code for concrete cover over reinforcement.

F. Bond and ground all reinforcement to requirements of Section 260526.

3.2 FIELD QUALITY CONTROL

A. An independent testing agency, as specified in Section 014000 - Quality Requirements, will inspect installed reinforcement for compliance with contract documents before concrete placement.

3.3 SCHEDULES – SEE DRAWINGS.

END OF SECTION 032000

SECTION 033000 – 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 other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes

1. Floors and slabs on grade.
2. Concrete foundation walls and spread footings.
3. Joint devices associated with concrete work.
4. Concrete curing.

1.3 RELATED REQUIREMENTS

A. Section 031000 - Concrete Forming and Accessories: Forms and accessories for formwork.

B. Section 032000 - Concrete Reinforcing.

C. Section 033511 - Concrete Floor Finishes: Densifiers, hardeners, applied coatings, and polishing.

D. Section 079200 - Joint Sealants: Products and installation for sealants and joint fillers for saw cut joints and isolation joints in slabs.

1.4 REFERENCE STANDARDS

A. ACI 211.1 - Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete; 1991 (Reapproved 2009).

B. ACI 211.2 - Standard Practice for Selecting Proportions for Structural Lightweight Concrete; 1998 (Reapproved 2004).

C. ACI 301 - Specifications for Structural Concrete; 2016.

D. ACI 302.1R - Guide to Concrete Floor and Slab Construction; 2015.

E. ACI 304R - Guide for Measuring, Mixing, Transporting, and Placing Concrete; 2000 (Reapproved 2009).

F. ACI 305R - Guide to Hot Weather Concreting; 2010.

G. ACI 306R - Guide to Cold Weather Concreting; 2016.

H. ACI 308R - Guide to External Curing of Concrete; 2016.

I. ACI 318 - Building Code Requirements for Structural Concrete and Commentary; 2014 (Errata 2018).

J. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2018, with Editorial Revision (2018).

K. ASTM C1602/C1602M - Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete; 2012.

L. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2016, with Editorial Revision (2016).

M. ASTM C39/C39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens; 2018.

N. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2017a.

O. ASTM C109/C109M - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or (50-mm) Cube Specimens); 2016a.

P. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic-Cement Concrete; 2015a.

Q. ASTM C150/C150M - Standard Specification for Portland Cement; 2018.

R. ASTM C173/C173M - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method; 2016.

S. ASTM C260/C260M - Standard Specification for Air-Entraining Admixtures for Concrete; 2010a (Reapproved 2016).

T. ASTM C330/C330M - Standard Specification for Lightweight Aggregates for Structural Concrete; 2017a.

U. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete; 2017.

V. ASTM C579 - Standard Test Methods for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes; 2001 (Reapproved 2012).

W. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete; 2015.

X. ASTM C827/C827M - Standard Test Method for Change in Height at Early Ages of Cylindrical Specimens of Cementitious Mixtures; 2016.

Y. ASTM C881/C881M - Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete; 2015.

Z. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink); 2014a.

AA. ASTM D471 - Standard Test Method for Rubber Property--Effect of Liquids; 2016a.

BB. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types); 2018.

CC. ASTM E1155 - Standard Test Method for Determining F(F) Floor Flatness and F(L) Floor Levelness Numbers; 2014.

DD. ASTM E1155M - Standard Test Method for Determining F(F) Floor Flatness and F(L) Floor Levelness Numbers (Metric); 2014.

EE. ASTM E1643 - Standard Practice for Selection, Design, Installation and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs; 2011 (Reapproved 2017).

FF. ASTM E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs; 2017.

GG. COE CRD-C 572 - Corps of Engineers Specifications for Polyvinylchloride Waterstop; 1974.

1.5 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Submit manufacturers' data on manufactured products showing compliance with specified requirements and installation instructions.

1. For curing compounds, provide data on method of removal in the event of incompatibility with floor covering adhesives.
2. For chemical-resistant waterstops, provide data on ASTM D471 test results.

C. Mix Design: Submit proposed concrete mix design.

1. Indicate proposed mix design complies with requirements of ACI 301, Section 4 - Concrete Mixtures.
2. Indicate proposed mix design complies with requirements of ACI 318, Chapter 5 - Concrete Quality, Mixing and Placing.

D. Samples: Submit samples of underslab vapor retarder to be used.

E. Samples: Submit two, 12 inch long samples of waterstops and construction joint devices.

F. Test Reports: Submit report for each test or series of tests specified.

G. Manufacturer's Installation Instructions: For concrete accessories, indicate installation procedures and interface required with adjacent construction.

H. Project Record Documents: Accurately record actual locations of embedded utilities and components that will be concealed from view upon completion of concrete work.

1.6 QUALITY ASSURANCE

A. Perform work of this section in accordance with ACI 301 and ACI 318.

1. Maintain one copy of each document on site.

B. Follow recommendations of ACI 305R when concreting during hot weather.

C. Follow recommendations of ACI 306R when concreting during cold weather.

1.7 WARRANTY

A. See Section 017800 - Closeout Submittals, for additional warranty requirements.

PART 2 - PRODUCTS

2.1 FORMWORK

A. Comply with requirements of Section 031000.

2.2 REINFORCEMENT MATERIALS

A. Comply with requirements of Section 032000.

2.3 CONCRETE MATERIALS

A. Cement: ASTM C150/C150M, Type II - Moderate Portland type.

1. Acquire cement for entire project from same source.

B. Fine and Coarse Aggregates: ASTM C33/C33M.

1. Acquire aggregates for entire project from same source.

C. Lightweight Aggregate: ASTM C330/C330M.

D. Fly Ash: ASTM C618, Class C or F; not to exceed 25% of cement content by weight.

E. Water: ASTM C1602/C1602M; clean, potable, and not detrimental to concrete.

2.4 ADMIXTURES

A. Do not use chemicals that will result in soluble chloride ions in excess of 0.1 percent by weight of cement. Concrete for slabs to receive a hard trowel finish shall not contain an air–entraining admixture.

B. Air Entrainment Admixture: ASTM C260/C260M.

1. Manufacturers:

a. BASF Chemical Company; Master Builders; Micro Air.
b. Substitutions: See Section 016000 - Product Requirements.

C. High Range Water Reducing Admixture: ASTM C494/C494M Type F.

1. Manufacturers:

a. Euclid Chemical Company; PLASTOL 6420: www.euclidchemical.com
b. Substitutions: See Section 016000 - Product Requirements.

2.5 ACCESSORY MATERIALS

A. Underslab Vapor Retarder: Sheet material complying with ASTM E1745, Class A; stated by manufacturer as suitable for installation in contact with soil or granular fill under concrete slabs. The use of single ply polyethylene is prohibited.

1. Installation: Comply with ASTM E1643.
2. Accessory Products: Vapor retarder manufacturer's recommended tape, adhesive, mastic, prefabricated boots, etc., for sealing seams and penetrations.
3. Manufacturers:

a. Fortifiber Building Systems Group: www.fortifiber.com/#sle.
b. Inteplast Group; Barrier-Bac VB-350: www.barrierbac.com/#sle.
c. ISI Building Products; Viper VaporCheck II 15-mil (Class A): www.isibp.com/#sle.
d. Stego Industries, LLC; 15 mils: www.stegoindustries.com/#sle.
e. W. R. Meadows, Inc; PERMINATOR Class A - 10 mils (0.25 mm): www.wrmeadows.com/#sle.
f. Substitutions: See Section 016000 - Product Requirements.

B. Non-Shrink Cementitious Grout: Premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents.

1. Grout: Comply with ASTM C1107/C1107M.
2. Height Change, Plastic State; when tested in accordance with ASTM C827/C827M:

a. Maximum: Plus 4 percent.
b. Minimum: Plus 1 percent.

3. Minimum Compressive Strength at 28 Days, ASTM C109/C109M: 5,000 pounds per square inch.

4. Products containing aluminum powder are not permitted.

5. Flowable Products:

   a. Euclid Chemical Company; NS GROUT: www.euclidchemical.com/#sle.
   b. Five Star Products, Inc; Five Star Fluid Grout 100: www.fivestarproducts.com/#sle.
   c. Kaufman Products Inc; SureGrout: www.kaufmanproducts.net/#sle.
   d. W. R. Meadows, Inc; CG-86: www.wrmeadows.com/#sle.
   e. Substitutions: See Section 016000 - Product Requirements.

C. Non-Shrink Epoxy Grout: Moisture-insensitive, two-part; consisting of epoxy resin, non-metallic aggregate, and activator.

1. Composition: High solids content material exhibiting positive expansion when tested in accordance with ASTM C827/C827M.

   a. Maximum Height Change: Plus 4 percent.
   b. Minimum Height Change: Plus 1 percent.

2. Minimum Compressive Strength at 7 days, ASTM C579: 12,000 pounds per square inch.
3. Manufacturers:

   a. Five Star Products, Inc; Five Star DP Epoxy Grout: www.fivestarproducts.com/#sle.
   b. Substitutions: See Section 016000 - Product Requirements.

2.6 BONDING AND JOINTING PRODUCTS

A. Epoxy Bonding System:

1. Complying with ASTM C881/C881M and of Type required for specific application.
2. Manufacturers:

   a. Adhesives Technology Corporation; Crackbond SLV-302, Crackbond LR-321, Crackbond LR-321 LPL, Ultrabond 2100 LPL, Ultrabond 2100, Ultrabond 1, Ultrabond 2, or Ultrabond HS200: www.atcepoxy.com/#sle.
   b. Euclid Chemical Company; DURAL FAST SET LV: www.euclidchemical.com/#sle.
   c. Dayton Superior Corporation: www.daytonsuperior.com/#sle.
   d. Kaufman Products Inc; SurePoxy HM EPL: www.kaufmanproducts.net/#sle.
   e. SpecChem, LLC; SpecPoxy 1000, SpecPoxy 2000, SpecPoxy 3000, or SpecPoxy 3000FS: www.specchemllc.com/#sle.

f. W. R. Meadows, Inc; Rezi-Weld Gel Paste, Rezi-Weld Gel Paste State, Rezi-Weld 1000: www.wrmeadows.com/#sle.

B. Waterstops: PVC, complying with COE CRD-C 572.

1. Configuration: As indicated on drawings.
2. Size: As indicated on drawings.
3. Manufacturers:

a. BoMetals, Inc: www.bometals.com/#sle.
b. Substitutions: See Section 016000 - Product Requirements.

C. Reglets: Formed steel sheet, galvanized, with temporary filler to prevent concrete intrusion during placement.

1. Size: As indicated on drawings.

D. Slab Isolation Joint Filler: 1/2 inch thick, height equal to slab thickness, with removable top section that will form 1/2 inch deep sealant pocket after removal.

1. Material: ASTM D1751, cellulose fiber.
2. Manufacturers:

a. Nomaco, Inc; Nomaflex Expansion Joint Filler with Void Cap Option: www.nomaco.com/#sle.
b. W. R. Meadows, Inc; Fiber Expansion Joint Filler with Snap-Cap: www.wrmeadows.com/#sle.
c. Substitutions: See Section 016000 - Product Requirements.

E. Dowel Sleeves: Plastic sleeve for smooth, round, steel load-transfer dowels.

1. Manufacturers:

a. BoMetals, Inc; QuicDowel: www.bometals.com/#sle.
b. Substitutions: See Section 016000 - Product Requirements.

2.7 CURING MATERIALS

A. Curing Compound, Naturally Dissipating: Clear, water-based, liquid membrane-forming compound; complying with ASTM C309.

1. Product dissipates within 4 to 6 weeks.
2. Provide product containing fugitive red dye.
3. Manufacturers:

a. Dayton Superior Corporation: www.daytonsuperior.com/#sle.
b. Euclid Chemical Company; COLOR-CRETE CURE AND SEAL VOC: www.euclidchemical.com/#sle.
c. Kaufman Products Inc; Thinfilm 420 Resin Base: www.kaufmanproducts.net/#sle.

d. W. R. Meadows, Inc; 1100-Clear: www.wrmeadows.com/#sle.
e. Substitutions: See Section 016000 - Product Requirements.

B. Clear, Waterborne, Membrane-Forming, Curing and Sealing Compound: ASTM C115, Type 1, Class A (Sealed Concrete "SCE-01" as indicated on the Drawings):

1. Subject to compliance with requirements, provide one of the following:

a. Euclid Chemical Company (The); an RPM company; Super Diamond Clear VOX.
b. Laticrete International, Inc.; L&M Dress & Seal WB 25.
c. Nox-Crete Products Group; Cure & Seal 250E.
d. TK Products; TK-Bright Kure & Seal 1315 VOC.
e. W.R. Meadows, Inc.; VOCOMP-30.

C. Water: Potable, not detrimental to concrete.

2.8 CONCRETE MIX DESIGN

A. Proportioning Normal Weight Concrete: Comply with ACI 211.1 recommendations.

1. Replace as much Portland cement as possible with fly ash, ground granulated blast furnace slag, silica fume, or rice hull ash as is consistent with ACI recommendations.

B. Proportioning Structural Lightweight Concrete: Comply with ACI 211.2 recommendations.

1. Replace as much Portland cement as possible with fly ash, ground granulated blast furnace slag, silica fume, or rice hull ash as is consistent with ACI recommendations.

C. Concrete Strength: Establish required average strength for each type of concrete on the basis of field experience or trial mixtures, as specified in ACI 301.

1. For trial mixtures method, employ independent testing agency acceptable to Architect for preparing and reporting proposed mix designs.

D. Admixtures: Add acceptable admixtures as recommended in ACI 211.1 and at rates recommended or required by manufacturer.

E. Normal Weight Concrete:

1. Compressive Strength, when tested in accordance with ASTM C39/C39M at 28 days: See structural drawings.
2. Fly Ash Content: See structural drawings.
3. Water-Cement Ratio: See structural drawings.
4. Total Air Content: 3 percent, determined in accordance with ASTM C173/C173M. Unless noted otherwise on structural drawings. Concrete to receive a hard trowel finish shall not have a total air content greater than 3 percent.
5. Aggregate Size: See structural drawings.

2.9 MIXING

A. Transit Mixers: Comply with ASTM C94/C94M.

B. Measurement of concrete materials, mixing, and delivery of fresh concrete to the project shall meet the requirements of ASTM C 94. Transit-mixed concrete supplier shall have a plant with sufficient capacity and transportation facilities to assure continuous delivery at the rate required.

C. Mix concrete in accordance with ASTM C 94, Alternative No. 2, or ACI 304.

D. Do not transport or use concrete after 90 minutes has expired from time of initial mixing.

E. Select proportions for normal weight concrete in accordance with ACI 301 Method 1. Mix not less than one minute after materials are in mixer.

F. Adding Water: If concrete arrives on-site with slump less than suitable for placement, do not add water that exceeds the maximum water-cement ratio or exceeds the maximum permissible slump.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify lines, levels, and dimensions before proceeding with work of this section.

B. Before any concrete is placed, the forms and reinforcement shall be inspected by the Contractor and the Owner’s testing laboratory. Notify the Owner’s testing laboratory not less than one working day before concrete is scheduled to be placed. Bucks, sleeves, anchors and other fixtures to be embedded in concrete shall be properly positioned and anchored. Wash down form surfaces to remove foreign substances. Provide elevated runways clearing steel and other embedded work.

C. Prepare previously placed concrete by cleaning with steel brush and applying bonding agent. Apply bonding agent in accordance with manufacturer's instructions.

D. At locations where new concrete is doweled to existing work, drill over-sized holes in existing concrete, insert steel dowels, and pack solid with non-shrink grout.

3.2 CONVEYING CONCRETE

A. Convey concrete to the place of final deposit by methods which will prevent the separation or loss of the ingredients. Equipment for chuting, pumping, and pneumatically conveying concrete shall be such as to assure a continuous flow of concrete at the delivery end without separation. The use of aluminum chutes or pipes for transporting concrete will not be permitted.

3.3 PREPARATION

A. Verify that forms are clean and free of rust before applying release agent.

B. Coordinate placement of embedded items with erection of concrete formwork and placement of form accessories.

C. Where new concrete is to be bonded to previously placed concrete, prepare existing surface by cleaning and applying bonding agent in according to bonding agent manufacturer's instructions.

1. Use epoxy bonding system for bonding to damp surfaces, for structural load-bearing applications, and where curing under humid conditions is required.

D. In locations where new concrete is doweled to existing work, drill holes in existing concrete, insert steel dowels and pack solid with non-shrink grout.

E. Interior Slabs on Grade: Install vapor retarder under interior slabs on grade. Lap joints minimum 6 inches. Seal joints, seams and penetrations watertight with manufacturer's recommended products and follow manufacturer's written instructions. Repair damaged vapor retarder before covering.

3.4 PLACING CONCRETE

A. Place concrete in accordance with ACI 304R.

B. Place concrete for floor slabs in accordance with ACI 302.1R.

C. Notify Architect and testing laboratory not less than 48 hours prior to commencement of placement operations.

D. Maintain records of concrete placement. Record date, location, quantity, air temperature, and test samples taken.

E. Ensure reinforcement, inserts, waterstops, embedded parts, and formed construction joint devices will not be disturbed during concrete placement.

F. Place concrete continuously without construction (cold) joints wherever possible; where construction joints are necessary before next placement prepare joint surface by removing laitance and exposing the sand and sound surface mortar.

G. Finish floors level and flat, unless otherwise indicated, within the tolerances specified below.

H. Place concrete in accordance with ACI 301 and as specified below:

1. Unless protection is provided, do not place concrete in rain, sleet, or snow.
2. Regulate rate of placement so concrete remains plastic and flows into position.
3. Deposit concrete continuously until panel or section is completed. Place as near as possible to its final location; do not rehandle.
4. Do not place concrete, under any circumstances, except in presence of testing laboratory.

5. When placing concrete in masonry, exercise extreme care to prevent concrete from staining face of masonry.
6. Consolidation

    a. Comply with requirements of ACI 309.
    b. Use mechanical vibrating equipment for consolidation.
    c. Do not use vibrators to transport concrete in forms.
    d. Use vibrators with sufficient speed and amplitude to consolidate effectively.
    e. Keep a spare vibrator on site during all concrete pours.
    f. Thoroughly consolidate concrete and work around reinforcement, embedded items and into corners of forms. Thoroughly consolidate layers of concrete with previous layers.

7. Expansion Joint Fillers: Place pre-molded expansion joint fillers at locations as detailed and whenever required to separate site paving from building slabs. Refer to Drawings for required joint dimensions. Reference SECTION 031000 - CONCRETE FORMING AND ACCESSORIES for joint filler products.
8. Bonding: Before depositing any new concrete on or against previously deposited concrete which has partially or entirely set, thoroughly roughen and clean the surfaces of the latter of all foreign matter, scum, and laitance. Re-tighten forms and re-coat the surface of the previously deposited concrete with specified bonding agent per manufacturer's directions.

I. Ensure reinforcement, inserts, embedded parts, and formed joints are not disturbed during concrete placement.

J. Place concrete continuously between predetermined construction and control joints. Do not break or interrupt successive pours such that cold joints occur.

K. Separate exterior slabs on fill from vertical surfaces with joint filler. Extend joint filler from bottom of slab to within ¼" of finished slab surface.

L. Excessive honeycomb or embedded debris in concrete is not acceptable. Notify Architect/Engineer upon discovery.

M. Maintain record of concrete placement. Record date, location, quantity, air temperature and test samples taken.

N. Beams and Walls: Place beams and walls continuously where possible. Start placing at ends of section and progress toward the center. Do not place concrete in beams and walls supported on piers until the concrete in the piers is no longer plastic.

O. Slabs: Place each slab in one continuous operation without joints within the area established for a continuous pour. Start placing at the far end of the area and place each load of concrete against previously placed concrete, not away from it.

P. Drains: Check the setting of floor drains so that they will finish flush with floor surfaces without varying the intended elevations and slopes. Slope surfaces down to drains at least 1/8" per foot or as shown and meet ADA requirements.

Q. Compaction: Compact concrete with ramming and spading tools during placing to work the coarse aggregate away from the forms and to produce a dense mass without air pockets. Work concrete through and around reinforcing steel. Do not disturb any embedded work.

R. Consolidation: Use high frequency mechanical vibrators to consolidate concrete and eliminate lift lines in walls exposed to view. Vibrators shall be operated by skilled mechanics under close supervision. Insert and withdraw the vibrator heads at points from 18" to 30" apart for short periods. Do not allow heads to touch the forms.

S. Leveling: Level and grade the top surface of slabs with straight edges over gauge strips. Level the top of foundations for the reception of subsequent work. Level and line steps in like manner over strips or forms. Remove wood spreaders, block, and screeds as the concrete is placed and before it sets.

T. Construction Joints: Generally, locate construction joints in beams and suspended slabs in the middle third of the span. Form each construction joint with a vertical bulkhead. Remove the bulkhead as soon as the concrete has attained its initial set and leave the surface rough. Before placing fresh concrete against the surface, coat the surface with bonding compound applied in conformance with the manufacturer's instructions.

U. Loading: Do not shake or move the forms and reinforcement nor place any strain on projecting metal after the concrete has taken its initial set. Do not permit loading or traffic of any kind on the construction until the concrete has fully hardened.

V. Hot Weather Placement: Take special care to prevent high temperatures in the fresh concrete during hot weather. Use a set-retarding type admixture to assure that concrete remains workable and lift lines will not be visible. For flatwork use a spray-on evaporation retardant as needed during finishing operations.

3.5 SLAB JOINTING

A. Locate joints as indicated on drawings.

B. Anchor joint fillers and devices to prevent movement during concrete placement.

C. Isolation Joints: Use preformed joint filler with removable top section for joint sealant, total height equal to thickness of slab, set flush with top of slab.

1. Install wherever necessary to separate slab from other building members, including columns, walls, equipment foundations, footings, stairs, manholes, sumps, and drains.

D. Load Transfer Construction and Contraction Joints: Install load transfer devices as indicated; saw cut joint at surface as indicated for contraction joints.

E. Saw cut joints in slab on grade as soon as slab is able to support weight of cutting equipment. Joints shall be located and cut as indicated in the construction document drawings.

3.6 FLOOR FLATNESS AND LEVELNESS TOLERANCES

A. An independent testing agency, as specified in Section 014000, will inspect finished slabs for compliance with specified tolerances.

B. Minimum F(F) Floor Flatness and F(L) Floor Levelness Values:

1. Exposed to View and Foot Traffic: F(F) of 20; F(L) of 15, on-grade only.Headers: AISI S212.
2. Under Thick-Bed Tile: F(F) of 20; F(L) of 15, on-grade only.
3. Under Carpeting: F(F) of 25; F(L) of 20, on-grade only.
4. Under Thin Resilient Flooring and Thinset Tile: F(F) of 35; F(L) of 25, on-grade only.

C. Measure F(F) Floor Flatness and F(L) Floor Levelness in accordance with ASTM E1155 (ASTM E1155M), within 48 hours after slab installation; report both composite overall values and local values for each measured section

D. Correct the slab surface if composite overall value is less than specified and if local value is less than two-thirds of specified value or less than F(F) 13/F(L) 10.

E. Correct defects by grinding or by removal and replacement of the defective work. Areas requiring corrective work will be identified. Re-measure corrected areas by the same process.

3.7 CONCRETE FINISHING

A. Repair surface defects, including tie holes, immediately after removing formwork.

B. Unexposed Form Finish: Rub down or chip off fins or other raised areas 1/4 inch or more in height.

C. Exposed Form Finish: Rub down or chip off and smooth fins or other raised areas 1/4 inch or more in height. Provide finish as follows:

1. Smooth Rubbed Finish: Wet concrete and rub with carborundum brick or other abrasive, not more than 24 hours after form removal.

D. Concrete Slabs: Finish to requirements of ACI 302.1R, and as follows:

1. Surfaces to Receive Thick Floor Coverings: "Wood float" as described in ACI 302.1R; thick floor coverings include quarry tile, ceramic tile, and Portland cement terrazzo with full bed setting system.
2. Surfaces to Receive Thin Floor Coverings: "Steel trowel" as described in ACI 302.1R; thin floor coverings include carpeting, resilient flooring, seamless flooring, resinous matrix terrazzo, thin set quarry tile, and thin set ceramic tile.
3. Decorative Exposed Surfaces: Trowel as described in ACI 302.1R; take measures necessary to avoid black-burnish marks; decorative exposed surfaces include surfaces to be stained or dyed, pigmented concrete, surfaces to receive liquid hardeners, surfaces to receive dry-shake hardeners, surfaces to be polished, and all other exposed slab surfaces.

E. In areas with floor drains, maintain floor elevation at walls; pitch surfaces uniformly to drains as indicated on drawings and meeting ADA slope requirements.

F. Concrete Polishing: See Section 033511.

3.8 CURING AND PROTECTION

A. Comply with requirements of ACI 308R. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.

B. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.

1. Normal concrete: Not less than seven days.

C. Formed Surfaces: Cure by moist curing with forms in place for full curing period.

D. Surfaces Not in Contact with Forms:

1. Slabs and Floors To Receive Adhesive-Applied Flooring: Curing compounds and other surface coatings are usually considered unacceptable by flooring and adhesive manufacturers. If such materials must be used, either obtain the approval of the flooring and adhesive manufacturers prior to use or remove the surface coating after curing to flooring manufacturer's satisfaction.
2. Initial Curing: Start as soon as free water has disappeared and before surface is dry. Keep continuously moist for not less than three days by water ponding, water-saturated sand, water-fog spray, or saturated burlap.

    a. Ponding: Maintain 100 percent coverage of water over floor slab areas, continuously for 4 days.
    b. Spraying: Spray water over floor slab areas and maintain wet.
    c. Saturated Burlap: Saturate burlap-polyethylene and place burlap-side down over floor slab areas, lapping ends and sides; maintain in place.

3. Final Curing: Begin after initial curing but before surface is dry.

    a. Moisture-Retaining Sheet: Lap strips not less than 3 inches and seal with waterproof tape or adhesive; secure at edges.
    b. Curing Compound: Apply in two coats at right angles, using application rate recommended by manufacturer.

3.9 FIELD QUALITY CONTROL

A. An independent testing agency will perform field quality control tests, as specified in Section 014000 - Quality Requirements.

B. Provide free access to concrete operations at project site and cooperate with appointed firm.

C. Submit proposed mix design of each class of concrete to inspection and testing firm for review prior to commencement of concrete operations.

D. Tests of concrete and concrete materials may be performed at any time to ensure compliance with specified requirements.

E. Compressive Strength Tests: ASTM C39/C39M, for each test, mold and cure three concrete test cylinders. Obtain test samples for every 75 cubic yards or less of each class of concrete placed.

F. Take one additional test cylinder during cold weather concreting, cured on job site under same conditions as concrete it represents.

G. Perform one slump test for each set of test cylinders taken, following procedures of ASTM C143/C143M.

H. Acceptance Tests:

1. Sampling procedures shall meet the requirements of ASTM C 172. If concrete is being pumped, take concrete samples for testing at the point of placement and not at the mixer discharge.
2. Make and record a slump test on each sample. The method of test shall meet the requirements of ASTM C 143.
3. Make 4 cylinders from each sample for strength tests, 1 for 7-day, 2 for 28-day test, and 1 in reserve. The cylinders shall be made on the project site by an Independent Testing Laboratory and shall be cured and tested in conformance with the requirements of ASTM C 31 and C 39.
4. Samples for 3-day strength tests may be taken at the Contractor's discretion and at the Contractor's expense.
5. Samples for temperature and slump tests of concrete shall be taken from each truck, of each mix design of concrete placed in any one day.
6. Testing lab representative shall be on site at all times during concrete pours.
7. No water shall be added to concrete mix on project site without approval from Owner's Testing Laboratory.
8. Concrete delivery tickets for all trucks shall be given to General Contractor for later submission to Owner. Delivery tickets shall record time truck left plant, time truck arrived at site and mix design number being delivered. A maximum of 90 minutes will be allowed from mixing of concrete to delivery.

I. EVALUATION OF TEST RESULTS:

1. Each strength test result shall be the average of 2 cylinders from the same sample tested at 28 days. Strength of each concrete mixture will be satisfactory if the average of any 3 consecutive compressive strength tests equals or exceeds the specified compressive strength and no individual strength test value falls below specified compressive strength by more than 500 psi.

2. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that compressive strengths or other requirements have not been met. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work.

J. The cost of testing service shall be per Section 014523 - Testing and Inspection Services

3.10 DEFECTIVE CONCRETE

A. Examine concrete for defects as the forms are removed. Concrete out of alignment or with defective surfaces shall be considered as not conforming to the intent of these specifications. Such concrete shall be removed from the project site unless the Architect grants permission to patch the defective area.

B. Concrete that does not attain the specified 28-day strength shall be removed from the project site at the contractor's expense.

C. Formed surfaces exposed to view shall not have fins, offsets, voids, and bulges. Minor grain marks will not be objectionable, but the texture shall be uniform. Leave corners and other details sharply defined and surfaces straight and true.

D. Repair honeycomb, pour joints, stone pockets, and like imperfections by wetting and pointing with mortar to match adjacent concrete. Where unacceptable surface blemishes occur on concrete exposed to view, rub the entire surface to produce a uniform appearance throughout.

E. Test Results: The testing agency shall report test results in writing to Architect and Contractor within 24 hours of test.

F. Defective Concrete: Concrete not complying with required lines, details, dimensions, tolerances or specified requirements.

G. Repair or replacement of defective concrete will be determined by the Architect. The cost of additional testing shall be borne by Contractor when defective concrete is identified.

H. Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of Architect for each individual area.

3.11 PROTECTION

A. Do not permit traffic over unprotected concrete floor surface until fully cured.

B. Floor Protection: All concrete floors which will be exposed to view in the completed building shall be covered with reinforced paper with joints lapped and sealed. Maintain the protective covering until all wet work in the building (masonry, plaster, and tile) is completed.

C. Clean Up: Excess concrete and wash water from concrete truck drums shall not be dumped anywhere on the site or on adjoining streets, but shall be disposed of away from the premises.

3.12 SCHEDULE - CONCRETE TYPES AND FINISHES - SEE DRAWINGS.

END OF SECTION 033000

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SECTION 042200 – CONCRETE MASONRY UNITS

PART 1 - GENERAL

1.1 Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes

1. Concrete block.
2. Mortar and grout.
3. Reinforcement and anchorage.
4. Flashings.
5. Accessories.

1.3 RELATED REQUIREMENTS

A. Section 079200 - Joint Sealants: Sealing control and expansion joints.

1.4 REFERENCE STANDARDS

A. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2018, with Editorial Revision (2018).

B. ASTM A641/A641M - Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire; 2009a (Reapproved 2014).

C. ASTM A951/A951M - Standard Specification for Steel Wire for Masonry Joint Reinforcement; 2016.

D. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete; 2018.

E. ASTM C90 - Standard Specification for Loadbearing Concrete Masonry Units; 2016a.

F. ASTM C91/C91M - Standard Specification for Masonry Cement; 2018.

G. ASTM C140/C140M - Standard Test Methods of Sampling and Testing Concrete Masonry Units and Related Units; 2018a.

H. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar; 2018.

I. ASTM C150/C150M - Standard Specification for Portland Cement; 2018.

J. ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes; 2018.

K. ASTM C270 - Standard Specification for Mortar for Unit Masonry; 2019.

L. ASTM C404 - Standard Specification for Aggregates for Masonry Grout; 2018.

M. ASTM C476 - Standard Specification for Grout for Masonry; 2018.

N. ASTM C780 - Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry; 2018a.

O. ASTM C1714/C1714M - Standard Specification for Preblended Dry Mortar Mix for Unit Masonry; 2016.

P. BIA Technical Notes No. 7 - Water Penetration Resistance – Design and Detailing; 2017.

Q. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures; 2016.

1.5 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by all relevant installers.

1.6 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data for masonry units, fabricated wire reinforcement, mortar, and masonry accessories.

C. Shop Drawings: Indicate pertinent dimensions, materials, anchorage, size and type of fasteners, and accessories for brickwork support system.

1. Include calculations or selections from the manufacturer's prescriptive design tables that indicate compliance with the applicable building code and project conditions.
2. Include the design engineer's stamp or seal on each sheet of shop drawings.

D. 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.

E. Test Reports: Concrete masonry manufacturer's test reports for units with integral water repellent admixture.

F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. See Section 016000 - Product Requirements, for additional provisions.

1.7 QUALITY ASSURANCE

A. Comply with provisions of TMS 402/602, except where exceeded by requirements of Contract Documents.

1. Maintain one copy of each document on project site.

B. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section with minimum three years of documented experience.

C. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

1.8 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 as follows:

1. Size: Standard units with nominal face dimensions of 16 by 8 inches and nominal depths as indicated on drawings for specific locations.
2. Special Shapes: Provide non-standard blocks configured for corners.

a. Provide bullnose units for outside corners. Field ground bullnose is not acceptable.

3. Load-Bearing Units: ASTM C90, normal weight.

a. Hollow block, as indicated.
b. Exposed Faces: Manufacturer's standard color and texture where indicated.

2.2 MORTAR AND GROUT MATERIALS

A. Masonry Cement: ASTM C91/C91M, Type S.

B. Portland Cement: ASTM C150/C150M, Type I; color as required to produce approved color sample.

1. Not more than 0.60 percent alkali.

C. Hydrated Lime: ASTM C207, Type S.

D. Mortar Aggregate: ASTM C144.

E. Grout Aggregate: ASTM C404.

F. Water: Clean and potable.

G. Packaged Dry Material for Mortar for Unit Masonry: Premixed Portland cement, hydrated lime, and sand; complying with ASTM C1714/C1714M and capable of producing mortar of the specified strength in accordance with ASTM C270 with the addition of water only.

1. Type: Type S.
2. Color: Standard gray.

2.3 REINFORCEMENT AND ANCHORAGE

A. Manufacturers:

1. Blok-Lok Limited: www.blok-lok.com/#sle.
2. Hohmann & Barnard, Inc: www.h-b.com/#sle.
3. WIRE-BOND: www.wirebond.com/#sle.

B. Reinforcing Steel: ASTM A615/A615M, Grade 60 (60,000 psi), deformed billet bars; galvanized.

C. Joint Reinforcement: Use ladder type joint reinforcement where vertical reinforcement is involved and truss type elsewhere, unless otherwise indicated.

D. Single Wythe Joint Reinforcement: ASTM A951/A951M.

1. Type: Truss or ladder.
2. Material: ASTM A1064/A1064M steel wire, mill galvanized to ASTM A641/A641M, Class 3.
3. Size: 0.1483 inch side rods with 0.1483 inch cross rods; width as required to provide not less than 5/8 inch of mortar coverage on each exposure.

E. Flexible Anchors: 2-piece anchors that permit differential movement between masonry and building frame, sized to provide not less than 5/8 inch of mortar coverage from masonry face.

F. Two-Piece Wall Ties: Formed steel wire, 0.1875 inch thick, adjustable, eye and pintle type, hot dip galvanized to ASTM A 153/A 153M, Class B, sized to provide not less than 5/8 inch of mortar coverage from masonry face and to allow vertical adjustment of up to 1-1/4 in. Anchors: 2-piece anchors that permit differential movement between masonry and building frame, sized to provide not less than 5/8 inch of mortar coverage from masonry face.

2.4 FLASHINGS

A. Drip Edge: Stainless steel; angled drip with hemmed edge; compatible with membrane and adhesives.

1. Manufacturers:

a. Mortar Net Solutions; Metal Drip Edges: www.mortarnet.com/#sle.

2.5 ACCESSORIES

A. Preformed Control Joints: Rubber material. Provide with corner and tee accessories, fused joints.

1. Manufacturers:

a. Blok-Lok Limited: www.blok-lok.com/#sle.
b. Hohmann & Barnard, Inc: www.h-b.com/#sle.
c. WIRE-BOND: www.wirebond.com/#sle.

B. Joint Filler: Closed cell polyvinyl chloride; oversized 50 percent to joint width; self expanding; in maximum lengths available.

1. Manufacturers:

a. Hohmann & Barnard, Inc: www.h-b.com/#sle.
b. WIRE-BOND: www.wirebond.com/#sle.

C. Cleaning Solution: Non-acidic, not harmful to masonry work or adjacent materials.

2.6 MORTAR AND GROUT MIXING

A. Mortar for Unit Masonry: ASTM C270, using the Proportion Specification.

1. Exterior, loadbearing masonry: Type S.
2. Exterior, non-loadbearing masonry: Type S.
3. Exterior or interior masonry below grade: Type M
4. Interior, loadbearing masonry: Type S.
5. Interior, non-loadbearing masonry: Type N or S.

B. Grout: ASTM C476; consistency required to fill completely volumes indicated for grouting; fine grout for spaces with smallest horizontal dimension of 2 inches or less; coarse grout for spaces with smallest horizontal dimension greater than 2 inches.

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.

3.3 COLD AND HOT WEATHER REQUIREMENTS

A. Maintain materials and surrounding air temperature to minimum 40 degrees F prior to, during, and 48 hours after completion of masonry work.

B. Maintain materials and surrounding air temperature to maximum 90 degrees F prior to, during, and 48 hours after completion of masonry work.

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: Running.
2. Coursing: One unit and one mortar joint to equal 8 inches.
3. Mortar Joints: Concave.

3.5 PLACING AND BONDING

A. Lay hollow masonry units with face shell bedding on head and bed joints.

B. Buttering corners of joints or excessive furrowing of mortar joints is not permitted.

C. Remove excess mortar and mortar smears as work progresses.

D. Remove excess mortar with water repellent admixture promptly. Do not use acids, sandblasting or high pressure cleaning methods.

E. Interlock intersections and external corners, except for units laid in stack bond.

F. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.

G. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.

H. Cut mortar joints flush where wall tile is scheduled or resilient base is scheduled.

I. Isolate masonry partitions from vertical structural framing members with a control joint as indicated.

J. Isolate top joint of masonry partitions from horizontal structural framing members and slabs or decks with compressible joint filler.

3.6 REINFORCEMENT AND ANCHORAGE - GENERAL, SINGLE WYTHE MASONRY, AND CAVITY WALL MASONRY

A. Unless otherwise indicated on drawings or specified under specific wall type, install horizontal joint reinforcement 16 inches on center.

B. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 16 inches each side of opening.

C. Place continuous joint reinforcement in first and second joint below top of walls.

D. Embed longitudinal wires of joint reinforcement in mortar joint with at least 5/8 inch mortar cover on each side.

E. Lap joint reinforcement ends minimum 6 inches.

F. Fasten anchors to structural framing and embed in masonry joints as masonry is laid. Unless otherwise indicated on drawings or closer spacing is indicated under specific wall type, space anchors at maximum of 36 inches horizontally and 24 inches vertically.

G. Embed ties and anchors in mortar joint and extend into masonry unit a minimum of 1-1/2 inches with at least 5/8 inch mortar cover to the outside face of the anchor.

3.7 MASONRY FLASHINGS

A. Whether or not specifically indicated, install masonry flashing to divert water to exterior at all locations where downward flow of water will be interrupted.

1. Extend flashings full width at such interruptions and at least 6 inches, minimum, into adjacent masonry or turn up flashing ends at least 1 inch, minimum, to form watertight pan at non-masonry construction.
2. Remove or cover protrusions or sharp edges that could puncture flashings.
3. Seal lapped ends and penetrations of flashing before covering with mortar.

B. Terminate flashing up 8 inches minimum on vertical surface of backing:

1. Install vertical leg of flashing behind water-resistive barrier sheet over backing.
2. Install vertical leg of flashing over fluid-applied or self-adhered air/vapor barriers over backing or per manufacturer’s directions.
3. Apply cap bead of sealant on top edge of self-adhered flashing.

C. Install flashing in accordance with manufacturer's instructions and BIA Technical Notes No. 7.

D. Extend metal flashings through exterior face of masonry and terminate in an angled drip with hemmed edge. Install joint sealer below drip edge to prevent moisture migration under flashing.

E. Extend laminated flashings to within 1/2 inch of exterior face of masonry and adhere to top of stainless steel angled drip with hemmed edge.

3.8 LINTELS

A. Install loose steel lintels over openings.

B. Install reinforced unit masonry lintels over openings where steel or precast concrete lintels are not scheduled.

1. Openings to 24 inches: Place two, No. 3 reinforcing bars 1 inch from bottom web.
2. Openings over 24 inches: Reinforce openings as detailed.
3. Do not splice reinforcing bars.
4. Support and secure reinforcing bars from displacement. Maintain position within 1/2 inch of dimensioned position.
5. Place and consolidate grout fill without displacing reinforcing.
6. Allow masonry lintels to attain specified strength before removing temporary supports.

C. Maintain minimum 4 inch bearing on each side of opening.

3.9 GROUTED COMPONENTS

A. Provide lap splices as indicated in structural drawings.

B. Support and secure reinforcing bars from displacement. Maintain position within 1/2 inch of dimensioned position.

C. Place and consolidate grout fill without displacing reinforcing.

D. At bearing locations, fill masonry cores with grout for a minimum 12 inches either side of opening.

3.10 CONTROL AND EXPANSION JOINTS

A. Do not continue horizontal joint reinforcement through control or expansion joints.

B. Install preformed control joint device in continuous lengths. Seal butt and corner joints in accordance with manufacturer's instructions.

C. Size control joints as indicated on drawings; if not indicated, 3/4 inch wide and deep.

D. Form expansion joint as detailed on drawings.

3.11 BUILT-IN WORK

A. As work progresses, install built-in metal door frames and glazed frames and other items to be built into the work and furnished under other sections.

B. Install built-in items plumb, level, and true to line.

C. Bed anchors of metal door and glazed frames in adjacent mortar joints. Fill frame voids solid with grout.

1. Fill adjacent masonry cores with grout minimum 12 inches from framed openings.

D. Do not build into masonry construction organic materials that are subject to deterioration.

3.12 TOLERANCES

A. Install masonry within the site tolerances found in TMS 402/602.

B. Maximum Variation from Alignment of Columns: 1/4 inch.

C. Maximum Variation From Unit to Adjacent Unit: 1/16 inch.

D. Maximum Variation from Plane of Wall: 1/4 inch in 10 ft and 1/2 inch in 20 ft or more.

E. Maximum Variation from Plumb: 1/4 inch per story non-cumulative; 1/2 inch in two stories or more.

F. Maximum Variation from Level Coursing: 1/8 inch in 3 ft and 1/4 inch in 10 ft; 1/2 inch in 30 ft.

G. Maximum Variation of Mortar Joint Thickness: Head joint, minus 1/4 inch, plus 3/8 inch.

H. Maximum Variation from Cross Sectional Thickness of Walls: 1/4 inch.

3.13 CUTTING AND FITTING

A. Cut and fit for chases, pipes, conduit, and sleeves. Coordinate with other sections of work to provide correct size, shape, and location.

B. Obtain approval prior to cutting or fitting masonry work not indicated or where appearance or strength of masonry work may be impaired.

3.14 FIELD QUALITY CONTROL

A. An independent testing agency will perform field quality control tests, as specified in Section 014000 - Quality Requirements.

B. Concrete Masonry Unit Tests: Test each variety of concrete unit masonry in accordance with ASTM C140/C140M for compliance with requirements of this specification.

C. Mortar Tests: Test each type of mortar in accordance with ASTM C780, testing with same frequency as masonry samples.

3.15 CLEANING

A. Remove excess mortar and mortar droppings.

B. Replace defective mortar. Match adjacent work.

C. Clean soiled surfaces with cleaning solution.

D. Use non-metallic tools in cleaning operations.

3.16 PROTECTION

A. Without damaging completed work, provide protective boards at exposed external corners that are subject to damage by construction activities.

END OF SECTION 042200

SECTION 042613 - MASONRY VENEER

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Brick.
2. Mortar materials.
3. Ties and anchors.
4. Embedded flashing.
5. Accessories.
6. Mortar mixes.

B. Products Installed but not Furnished under This Section:

1. Cast-stone trim in masonry veneer.
2. Steel lintels in masonry veneer.
3. Steel shelf angles for supporting masonry veneer.

C. Related Requirements:

1. Section 014339 "Mockups" for integrated exterior mockup requirements.
2. Section 042200 “Concrete Unit Masonry” for CMUs and CMU joint reinforcement with brick tie eyes.

1.2 DEFINITIONS

A. CMU(s): Concrete masonry unit(s).

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For the following:

1. Masonry Units: Indicate sizes, profiles, coursing, and locations of special shapes.
2. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.

C. Samples for Initial Selection:

1. Weep/cavity vents.

D. Samples for Verification: For each type and color of the following:

1. Clay face brick, in the form of straps of five or more bricks.
2. Pigmented and colored-aggregate mortar. Make Samples using same sand and mortar ingredients to be used on Project.

1.5 INFORMATIONAL SUBMITTALS

A. Material Certificates: For each type and size of the following:

1. Masonry units.

a. Include data on material properties material test reports substantiating compliance with requirements.
b. For brick, include size-variation data verifying that actual range of sizes falls within specified tolerances.
c. For exposed brick, include test report for efflorescence in accordance with ASTM C67/C67M.

2. Cementitious materials. Include name of manufacturer, brand name, and type.
3. Mortar admixtures.
4. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
5. Anchors, ties, and metal accessories.

B. Qualification Statements: For testing agency.

C. Mix Designs: For each type of mortar. Include description of type and proportions of ingredients.

1. Include test reports for mortar mixes required to comply with property specification. Test in accordance with ASTM C109/C109M for compressive strength, ASTM C1506 for water retention, and ASTM C91/C91M for air content.

D. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

1.6 MOCKUPS

A. Wall Mockups: Build mockups to verify selections made under Sample submittals and to set quality standards for materials and execution. See Section 014339 "Mockups" for additional construction requirements for integrated exterior mockups.

1. Build mockups for typical exterior wall in sizes approximately 48 inches long by 48 inches high by full thickness, including face and backup wythes and accessories.

a. Include a sealant-filled joint at least 16 inches long in mockup.
b. Include lower corner of window opening, framed with stone trim, at upper corner of exterior wall mockup. Make opening approximately 12 inches wide by 16 inches high.
c. Include through-wall flashing installed for a 24-inch length in corner of exterior wall mockup approximately 16 inches down from top of mockup, with a 12-inch length of flashing left exposed to view (omit masonry above half of flashing).
d. Include air barrier, veneer anchors, flashing, cavity drainage material, and weep holes in exterior masonry-veneer wall mockup.

2. Where masonry is to match existing, erect mockups adjacent and parallel to existing surface.
3. Clean one-half of exposed faces of mockups with masonry cleaner as indicated.
4. Protect accepted mockups from the elements with weather-resistant membrane.
5. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.

B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

D. Deliver preblended, dry mortar mix in moisture-resistant containers. Store preblended, dry mortar mix in delivery containers on elevated platforms in a dry location or in covered weatherproof dispensing silos.

E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.8 FIELD CONDITIONS

A. Protection of Masonry: During construction, cover tops of veneer, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.

1. Extend cover a minimum of 24 inches down face of veneer, and hold cover securely in place.

B. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry. Immediately remove grout, mortar, and soil that come in contact with masonry.

1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
2. Protect sills, ledges, and projections from mortar droppings.
3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.

C. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in TMS 602.

1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.

D. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. For exposed masonry units and cementitious mortar components, obtain each color and grade from single source with resources to provide materials of consistent quality in appearance and physical properties.

2.2 UNIT MASONRY, GENERAL

A. Masonry Standard: Comply with TMS 602, except as modified by requirements in the Contract Documents.

B. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated. Do not use units where such defects will be exposed in the completed Work.

2.3 BRICK

A. General: Provide shapes indicated and as follows, with exposed surfaces matching finish and color of exposed faces of adjacent units.

1. 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.

2. Provide special shapes for applications where shapes produced by sawing would result in sawed surfaces being exposed to view.

B. Clay Face Brick: Facing brick complying with ASTM C216, Grade SW, Type FBX.

1. Initial Rate of Absorption: Less than 30 g/30 sq. in. per minute when tested in accordance with ASTM C67/C67M.
2. Efflorescence: Provide brick that has been tested in accordance with ASTM C67/C67M and is rated "not effloresced."
3. Size (Actual Dimensions): King; 3 inches wide by 2-5/8 inches high by 9-5/8 inches long.
4. Application: Use where brick is exposed unless otherwise indicated.
5. Where shown to "match existing," provide clay face brick matching color range, texture, and size of existing adjacent brickwork.
6. Color and Texture:

a. Brick-01 (BR-01):

1) Manufacturer: Cloud Ceramics.

a) Color: Burgandy.
b) Texture: Velour.

b. Brick-02 (BR-02):

1) Manufacturer: Kansas Brick & Tile.

a) Color: Mahogany.
b) Texture: Smooth.

2.4 MORTAR MATERIALS

A. Portland Cement: ASTM C150/C150M, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.

1. Alkali content will not be more than 0.1 percent when tested in accordance with ASTM C114.

B. Hydrated Lime: ASTM C207, Type S.

C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.

D. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C979/C979M. Use only pigments with a record of satisfactory performance in masonry mortar.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Davis Colors.
    b. Euclid Chemical Company (The); an RPM company.
    c. Lanxess Corporation.
    d. Solomon Colors Inc.

E. Colored Cement Products: Packaged blend made from portland cement and hydrated lime and mortar pigments, all complying with specified requirements, and containing no other ingredients.

1. Colored Portland Cement-Lime Mix:

    a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

        1) Argos USA LLC.
        2) Holcim (US) Inc.
        3) Lehigh Hanson; HeidelbergCement Group.

2. Formulate blend as required to produce color indicated or, if not indicated, as selected from manufacturer's standard colors.
3. Pigments do not exceed 10 percent of portland cement by weight.

F. Preblended Dry Mortar Mix: Packaged blend made from portland cement and hydrated lime, sand, mortar pigments if required to match existing mortar, and admixtures and complying with ASTM C1714/C1714M.

1. Preblended Dry Portland Cement Mortar Mix:

    a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

        1) Amerimix is a trademark of Bonsal American, an Oldcastle company.
        2) Quikrete; The QUIKRETE Companies, LLC.
        3) SPEC MIX, LLC.
        4) Sakrete; CRH Americas, Oldcastle APG.

G. Aggregate for Mortar: ASTM C144.

1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
2. For joints less than 1/4 inch thick, use aggregate graded with 100 percent passing the No. 16 sieve.
3. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.

H. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C494/C494M, Type C ASTM C1384, and recommended by manufacturer for use in masonry mortar of composition indicated.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Euclid Chemical Company (The); an RPM company.
b. GCP Applied Technologies Inc.

I. Water: Potable.

2.5 TIES AND ANCHORS

A. General: Ties and anchors extend at least 1-1/2 inches into veneer but with at least a 5/8-inch cover on outside face.

B. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated:

1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A1064/A1064M, with ASTM A153/A153M, Class B-2 coating.
2. Steel Sheet, Galvanized after Fabrication: ASTM A1008/A1008M, Commercial Steel, with ASTM A153/A153M, Class B coating.

C. Adjustable Masonry-Veneer Anchors:

1. General: Provide anchors that allow vertical adjustment but resist a 200 lbf load in both tension and compression perpendicular to plane of wall without deforming or developing play in excess of 1/16 inch.
2. Fabricate sheet metal anchor sections and other sheet metal parts from 0.1084-inch- (14-gauge) thick steel sheet, galvanized after fabrication.
3. Fabricate wire ties from 0.187-inch- diameter, hot-dip galvanized steel wire unless otherwise indicated.
4. Contractor's Option: Unless otherwise indicated, provide any of the adjustable masonry-veneer anchors specified as follows:

a. CMU joint reinforcement per Section 042200 “Concrete Unit Masonry” with adjustable (two-piece) type, either ladder or truss design, with one side rod at each face shell of backing wythe and with separate adjustable ties with pintle-and-eye connections having a maximum horizontal play of 1/16 inch and maximum vertical adjustment of 1-1/4 inches. Size ties to extend at least halfway through facing wythe but with at least 5/8-inch cover on outside face.

1) Basis-of-Design Product: Subject to compliance with requirements, provide Hohmann & Barnard, Inc; 270-2X Ladder Eye-Wire or comparable product by one of the following:

a) Wire-Bond.

b. Masonry-Veneer Anchors; Single-Barrel Screw with Double-Pintle Wingnut: Self-drilling, single-barrel screw with thermally resistant wingnut head designed to receive double-pintle wire tie. Screw has a smooth barrel the same thickness as insulation with factory-installed gasketed washer to seal at face of insulation and a coating to reduce thermal conductivity.

1) Product: Subject to compliance with requirements, provide the following:

a) Hohmann & Barnard, Inc; Thermal Concrete 2-Seal™ Wing Nut Anchor.

2.6 EMBEDDED FLASHING

A. Metal Flashing: Provide metal flashing complying with SMACNA's "Architectural Sheet Metal Manual" and as follows:

1. Stainless Steel: ASTM A240/A240M or ASTM A666, Type 304, 0.016 inch thick.
2. Fabricate continuous flashings in sections 96 inches long minimum, but not exceeding 12 ft.. Provide splice plates at joints of formed, smooth metal flashing.
3. Fabricate metal drip edges from stainless steel. Extend at least 1 5/8 inches (38 mm) into wall and 3/16-inch (10 mm) out from wall, with outer edge bent down 30 degrees and hemmed. Provide prefabricated inside and outside corners, 8 inches by 8 inches (203 mm by 203 mm) long.

a. Products: Subject to compliance with requirements, provide one of the following products:

1) Hohmann & Barnard, Inc.: DP Series Drip Plate.
2) Illinois Products Corporation; IPCO Drip Edge and Preformed Corners.
3) Wire-Bond: #4165 Drip Edge Flashing.
4) York Flashings; SS Drip Edge & Corners.

B. Flexible Flashing: Use the following unless otherwise indicated:

1. Self-Adhering, Stainless Steel Fabric Flashing: Composite, flashing product consisting of 2 mil of Type 304 stainless steel sheet, bonded to a layer of polymeric fabric with a butyl adhesive.

a. Products: Subject to compliance with requirements, provide one of the following:

1) Illinois Products, Inc.; IPCO Self-Adhesive Stainless Steel.
2) STS Coatings, Inc.; Gorilla Flash SS peel & stick butyl.
3) VaproShield LLC; Vapro-SS Flashing.
4) Wire-Bond; Bond-N-Flash SA.

5) York Flashings; York 304 SA.

b. Performance Attributes:

1) Tensile strength, greater than 90,000 psi minimum.
2) Puncture Resistance, greater than 2,500 pounds average.
3) When tested as manufactured, product resists growth of mold pursuant to test method ASTM D3273.
4) Flashing materials must be able to withstand 400º F temperature without changing the long-term performance of the flashing.
5) Certify the use of domestic manufactured stainless steel for flashing.

2. Prefabricated Corners and End Dams: Provide 26-gauge stainless steel prefabricated inside/outside corners and end dams.

C. Metal Flashing Application:

1. Where flashing is indicated to be turned down at or beyond the wall face, use metal drip edge flashing.
2. Where flashing is fully concealed, use flexible flashing.

D. Sealants for Sheet Metal Flashings:

1. Elastomeric Sealant: ASTM C920, chemically curing urethane sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and remain watertight.

a. Products: Provide one of the following as recommended by self-adhering flexible flashing manufacturer:

1) Prosoco, Inc.; R-Guard Joint Seam Sealer.
2) STS Coatings; GreatSeal LT-100.
3) York Manufacturing, Inc.; UniverSeal US-100.

E. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.

1. Splice Tape:

a. GE Silicones, Inc.; GE Elemax SS Flashing.
b. Illinois Products, Inc.; IPCO Self Adhering Stainless-Steel Flashing.
c. VaproShield LLC.; Vapro-SS Flashing.
d. York Manufacturing, Inc.; York 304 SA.

F. Termination Bars for Flexible Flashing, Flanged: Stainless steel sheet 0.019 inch by 1-1/2 inches with a 3/8-inch flange at top and bottom.

2.7 CAVITY-WALL INSULATION

A. Extruded Polystyrene Board Insulation, Type IV (XPS): ASTM C578, Type IV, 25-psi minimum compressive strength; unfaced.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. DuPont de Nemours, Inc.
b. Owens Corning.
c. The Dow Chemical Company.

2. Flame-Spread Index: Not more than 25 when tested in accordance with ASTM E84.
3. Smoke-Developed Index: Not more than 450 when tested in accordance with ASTM E84.
4. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.
5. Labeling: Provide identification of mark indicating R-value of each piece of insulation 12 inches and wider in width.

B. Adhesive: Type recommended by insulation board manufacturer for application indicated.

C. Joint Tape: Type recommended by insulation board manufacturer for sealing joints between insulation boards.

2.8 ACCESSORIES

A. Compressible Filler: Premolded filler strips complying with ASTM D1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene or urethane.

B. Weep/Vent Products: Use the following unless otherwise indicated:

1. Wicking Material for Stone Trim: Absorbent rope, made from cotton, 1/4 to 3/8 inch in diameter, in length required to produce 2-inch exposure on exterior and 18 inches in cavity. Use only for weeps.
2. Cellular Plastic Weep/Vent for Face Brick: One-piece, flexible extrusion made from UV-resistant polypropylene copolymer, full height and width of head joint and depth 1/8 inch less than depth of outer wythe, in color selected from manufacturer's standard.

a. Products: Subject to compliance with requirements, provide one of the following:

1) Advanced Building Products Inc.; Mortar Maze Weep Vent.
2) Heckmann Building Products, Inc.; No. 85 Cell Vent.
3) Hohmann & Barnard, Inc; QV Quadro-Vent.
4) Mortar Net Solutions; CellVent.
5) Wire-Bond; Cell Vent (#3601).

C. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity.

1. Mortar Deflector: Strips, full depth of cavity and 10 inches high, with dovetail-shaped notches that prevent clogging with mortar droppings.

a. Products: Subject to compliance with requirements, provide one of the following:

1) Advanced Building Products Inc.; Mortar Break DT.
2) Hohmann & Barnard, Inc; Mortar Trap.
3) Mortar Net Solutions; Mortar Net with Insect Barrier.
4) Wire-Bond; Cavity Net DT.
5) York Manufacturing, Inc; Weep-Net.

D. Proprietary Acidic Masonry Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Diedrich Technologies, Inc.; a Hohmann & Barnard company.
b. EaCo Chem, Inc.
c. PROSOCO, Inc.

2.9 MORTAR MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.

1. Do not use calcium chloride in mortar or grout.
2. Use portland cement-lime mortar unless otherwise indicated.
3. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.

B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.

C. Mortar for Unit Masonry: Comply with ASTM C270, Proportion Property Specification. Use Type N unless another type is indicated.

D. Pigmented Mortar: Use colored cement product.

1. Pigments do not exceed 10 percent of portland cement by weight.

2. Match existing mortar.
3. Application: Use pigmented mortar for exposed mortar joints.

E. Colored-Aggregate Mortar: Produce required mortar color by using colored aggregates and natural color or white cement as necessary to produce required mortar color.

1. Match existing mortar.
2. Application: Use colored-aggregate mortar for exposed mortar joints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to opening.

B. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

C. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures. Mix units from several pallets or cubes as they are placed.

D. Matching Existing Masonry: Match coursing, bonding, color, and texture of existing masonry.

E. Wetting of Brick: Wet brick before laying if initial rate of absorption exceeds 30 g/30 sq. in. per minute when tested in accordance with ASTM C67/C67M. Allow units to absorb water so they are damp but not wet at time of laying.

3.3 TOLERANCES

A. Dimensions and Locations of Elements:

1. For dimensions in cross section or elevation, do not vary by more than plus 1/2 inch or minus 1/4 inch.

2. For location of elements in plan, do not vary from that indicated by more than plus or minus 1/2 inch.
3. For location of elements in elevation, do not vary from that indicated by more than plus or minus 1/4 inch in a story height or 1/2 inch total.

B. Lines and Levels:

1. For bed joints and top surfaces of bearing walls, do not vary from level by more than 1/4 inch in 10 ft., or 1/2-inch maximum.
2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 ft., 1/4 inch in 20 ft., or 1/2-inch maximum.
3. For vertical lines and surfaces, do not vary from plumb by more than 1/4 inch in 10 ft., 3/8 inch in 20 ft., or 1/2-inch maximum.
4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 ft., 1/4 inch in 20 ft., or 1/2-inch maximum.
5. For lines and surfaces, do not vary from straight by more than 1/4 inch in 10 ft., 3/8 inch in 20 ft., or 1/2-inch maximum.
6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 ft., or 1/2-inch maximum.
7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch except due to warpage of masonry units within tolerances specified for warpage of units.

C. Joints:

1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch.
2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.
3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch or minus 1/4 inch.
4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch. Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch.
5. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than 1/16 inch from one masonry unit to the next.

3.4 LAYING MASONRY WALLS

A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

B. Bond Pattern for Exposed Masonry (King Size Face Brick): Unless otherwise indicated, lay exposed masonry in one-third (1/3) running bond; do not use units with less-than-nominal 4-inch horizontal face dimensions at corners or jambs.

C. Stopping and Resuming Work: Stop work by stepping back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.

D. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

E. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.

3.5 MORTAR BEDDING AND JOINTING

A. Lay masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.

B. Set cast-stone trim units in full bed of mortar with full vertical joints.

1. Clean soiled surfaces with fiber brush and soap powder and rinse thoroughly with clear water.
2. Allow cleaned surfaces to dry before setting.
3. Wet joint surfaces thoroughly before applying mortar.

C. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

3.6 ANCHORED MASONRY VENEERS

A. Anchor masonry veneers to masonry backup with masonry-veneer anchors to comply with the following requirements:

1. Attach pintle hook to joint reinforcing eyes or fasten screw-attached anchors masonry backup with metal fasteners of type indicated. Use two fasteners unless anchor design only uses one fastener.
2. Embed tie sections in masonry joints.
3. Locate anchor sections to allow maximum vertical differential movement of ties up and down.
4. Space anchors as indicated, but not more than 16 inches o.c. vertically and horizontally. Install additional anchors within 12 inches of openings and at intervals, not exceeding 24 inches, around perimeter.

B. Provide not less than 2 inches of airspace between back of masonry veneer and face of insulation.

1. Keep airspace clean of mortar droppings and other materials during construction. Bevel beds away from airspace, to minimize mortar protrusions into airspace. Do not attempt to trowel or remove mortar fins protruding into airspace.

3.7 EXPANSION JOINTS

A. General: Install expansion-joint materials in unit masonry as masonry progresses. Do not allow materials to span expansion joints without provision to allow for in-plane wall or partition movement.

B. Form expansion joints as follows:

1. Build flanges of metal expansion strips into masonry. Lap each joint 4 inches in direction of water flow. Seal joints below grade and at junctures with horizontal expansion joints if any.
2. Build flanges of factory-fabricated, expansion-joint units into masonry.
3. Build in compressible joint fillers where indicated.
4. Form open joint full depth of brick wythe and of width indicated, but not less than 3/8 inch for installation of sealant and backer rod specified in Section 079200 "Joint Sealants."

3.8 LINTELS

A. Install steel lintels where indicated.

3.9 FLASHING, WEEP HOLES, AND VENTS

A. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated. Install vents at shelf angles, ledges, and other obstructions to upward flow of air in cavities, and where indicated.

B. Install flashing as follows unless otherwise indicated:

1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
2. At multiwythe masonry walls, including cavity walls, extend flashing from 1/2 inch back of the exterior face of outer wythe of masonry, through outer wythe, turned up a minimum of 8 inches (200 mm) or as indicated on the Drawings and securely anchor top of flashing with termination bar and sealant. When starting the flashing at the exterior wall, set the flashing in a continuous bead of sealant.
3. Top of the flashing shall extend a minimum of 2 inches (50.8 mm) above the top of the cavity drainage material as indicated on the Drawings, unless noted otherwise.
4. After installing flexible flashing over steel lintels installed with anchor bolts, cover bolt head with a 6-by-6 inch (152-by-152 mm) patch of self-adhering flexible flashing material with continuous sealant or mastic around perimeter of patch.
5. At brick expansion joints, turn up flashing not less than 2 inches each side to form end dams.

6. At lintels and shelf angles, extend flashing 6 inches minimum at each end. At heads and sills, extend flashing 6 inches minimum and turn ends up not less than 2 inches to form end dams.
7. At base of walls, steel lintels, shelf angles, and cast stone sills, install metal drip edges beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch back from outside face of wall, and adhere flexible flashing to top of metal drip edge. Seal joints between pieces of metal drip edges.

C. Install reglets and nailers for flashing and other related construction where they are indicated to be built into masonry.

D. Install weep holes in veneers in head joints of first course of masonry immediately above embedded flashing.

1. Use specified weep/cavity vent products to form weep holes, except under cast stone sills.
2. Use wicking material to form weep holes above flashing under cast-stone sills. Turn wicking down at lip of sill to be as inconspicuous as possible.
3. Space weep/cavity vents 24 inches o.c. unless otherwise indicated.
4. Space weep holes formed from wicking material 16 inches o.c.
5. Trim wicking material flush with outside face of wall after mortar has set.

E. Place cavity drainage material immediately above flashings in airspace behind veneers to comply with configuration requirements for cavity drainage material in "Accessories" Article.

F. Install vents in head joints in exterior wythes at spacing indicated. Use specified weep/cavity vent products to form vents.

3.10 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections. Allow inspectors access to scaffolding and work areas as needed to perform tests and inspections. Retesting of materials that fail to comply with specified requirements will be at Contractor's expense.

B. Inspections: Special inspections in accordance with Level 2 in TMS 402.

C. Clay Masonry Unit Test: For each type of unit provided, in accordance with ASTM C67/C67M for compressive strength.

D. Mortar Test (Property Specification): For each mix provided, in accordance with ASTM C780. Test mortar for mortar air content and compressive strength.

3.11 REPAIRING, POINTING, AND CLEANING

A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.

B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.

C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:

1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
5. Clean brick by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.
6. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.

3.12 MASONRY WASTE DISPOSAL

A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site and dispose or recycle materials.

END OF SECTION 042613

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SECTION 047200 - CAST STONE MASONRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Trim units.
2. Accessories.

B. Related Requirements:

1. Section 042000 “Unit Masonry” for face brick, mortar, and installation.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. For cast stone units, include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: Show fabrication and installation details for cast stone units. Include dimensions, details of reinforcement and anchorages if any, and indication of finished faces.

1. Include building elevations showing layout of units and locations of joints and anchors.

C. Samples for Verification:

1. For each color and texture of cast stone required, 4 inches square in size.

D. Full-Size Samples: For each color, texture, and shape of cast stone unit required.

1. Make available for Architect's review at Project site or at manufacturing plant, if acceptable to Architect.
2. Make Samples from materials to be used for units used on Project.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and testing agency.

1. Include copies of material test reports, indicating compliance of cast stone with ASTM C1364.

B. Material Test Reports: For each mix required to produce cast stone, based on testing according to ASTM C1364.

1. Provide test reports based on testing within previous six months.

C. Field quality control reports.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer of cast stone units similar to those indicated for this Project, that has sufficient production capacity to manufacture required units, and is a plant certified by Cast Stone Institute or Architectural Precast Association.

B. Furnish cast stone for installation in mockups specified in Section 042000 "Unit Masonry."

1.5 DELIVERY, STORAGE, AND HANDLING

A. Coordinate delivery of cast stone with unit masonry work to avoid delaying the Work.

B. Pack, handle, and ship cast stone units in suitable packs or pallets.

1. Lift with wide-belt slings; do not use wire rope or ropes that might cause staining. Move cast stone units if required, using dollies with wood supports.
2. Store cast stone units on wood skids or pallets with nonstaining, waterproof covers, securely tied. Arrange to distribute weight evenly and to prevent damage to units. Ventilate under covers to prevent condensation.

1.6 PROJECT CONDITIONS

A. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Comply with cold-weather construction requirements in TMS 602.

1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and above and will remain so until cast stone has dried, but no fewer than seven days after completing cleaning.

B. Hot-Weather Requirements: Comply with hot-weather construction requirements in TMS 602.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations for Cast Stone: Obtain cast stone units from single source from single manufacturer.

B. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color, from one manufacturer for each cementitious component and from one source or producer for each aggregate.

2.2 CAST STONE MATERIALS

A. General: Comply with ASTM C1364.

B. Portland Cement: ASTM C150/C150M, Type I or Type III, containing not more than 0.60 percent total alkali when tested according to ASTM C114. Provide natural color or white cement as required to produce cast stone color indicated.

C. Coarse Aggregates: Granite, quartz, or limestone complying with ASTM C33/C33M; gradation and colors as needed to produce required cast stone textures and colors.

D. Fine Aggregates: Natural sand or crushed stone complying with ASTM C33/C33M, gradation and colors as needed to produce required cast stone textures and colors.

E. Color Pigment: ASTM C979/C979M, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, free of carbon black, nonfading, and resistant to lime and other alkalis.

F. Admixtures: Use only admixtures specified or approved in writing by Architect.

1. Do not use admixtures that contain more than 0.1 percent water-soluble chloride ions by mass of cementitious materials. Do not use admixtures containing calcium chloride.
2. Use only admixtures that are certified by manufacturer to be compatible with cement and other admixtures used.
3. Air-Entraining Admixture: ASTM C260/C260M.
4. Water-Reducing Admixture: ASTM C494/C494M, Type A.
5. Water-Reducing, Retarding Admixture: ASTM C494/C494M, Type D.
6. Water-Reducing, Accelerating Admixture: ASTM C494/C494M, Type E.

G. Water Repellents and Other Chemical Admixtures: Previously established as suitable for use in concrete by proven field performance or through laboratory testing.

H. Water: Potable.

I. Reinforcement:

1. Deformed steel bars complying with ASTM A615/A615M, Grade 40. Use galvanized or epoxy-coated reinforcement when covered with less than 1-1/2 inches of cast stone material.

a. Epoxy Coating: ASTM A775/A775M.
b. Galvanized Coating: ASTM A767/A767M.

2. Fiber Reinforcement: ASTM C1116/C1116M.

J. Embedded Anchors and Other Inserts: Fabricated from stainless steel complying with ASTM A240/A240M, ASTM A276/A276M, or ASTM A666, Type 304 steel complying with ASTM A36/A36M and hot-dip galvanized to comply with ASTM A123/A123M.

2.3 CAST STONE UNITS (ST-01)

A. Basis-of-Design Product: Subject to compliance with requirements, provide cast sone units by Arriscraft International; A General Shale Company; Arria-Cast Units or comparable product.

1. Stretcher Unit Size: 3 5/8 inches bed depth by 3 5/8 inches high by 23 5/8 inches long.

B. Cast Stone Units: Comply with ASTM C1364.

1. Units are manufactured using the vibrant dry tamp method.
2. Trim units including window sills, belt courses, and items as indicated on Drawings.

C. Fabricate units with sharp arris and accurately reproduced details, with indicated texture on all exposed surfaces unless otherwise indicated.

1. Slope exposed horizontal surfaces 1:12 to drain unless otherwise indicated.
2. Provide raised fillets at backs of sills and at ends indicated to be built into jambs.
3. Provide drips on projecting elements unless otherwise indicated.

D. Fabrication Tolerances:

1. Variation in Cross Section: Do not vary from indicated dimensions by more than 1/8 inch.
2. Variation in Length: Do not vary from indicated dimensions by more than 1/360 of the length of unit or 1/8 inch, whichever is greater, but in no case by more than 1/4 inch.
3. Warp, Bow, and Twist: Not to exceed 1/360 of the length of unit or 1/8 inch, whichever is greater.
4. Location of Grooves, False Joints, Holes, Anchorages, and Similar Features: Do not vary from indicated position by more than 1/8 inch on formed surfaces of units and 3/8 inch on unformed surfaces.

E. Cure Units as Follows:

1. Cure units in enclosed, moist curing room at 95 percent relative humidity and temperature of 100 deg F for 12 hours or 70 deg F for 16 hours.
2. Keep units damp and continue curing to comply with one of the following:

    a. No fewer than five days at mean daily temperature of 70 deg F or above.
    b. No fewer than seven days at mean daily temperature of 50 deg F or above.

F. Colors and Texture: Basis-of-Design, Arriscraft; Oak Ridge, Rocked.

2.4 ACCESSORIES

A. Anchors: Type and size indicated, fabricated from Type 304 stainless steel complying with ASTM A240/A240M, ASTM A276/A276M, or ASTM A666.

B. Dowels: 1/2-inch- diameter round bars, fabricated from Type 304 stainless steel complying with ASTM A240/A240M, ASTM A276/A276M, or ASTM A666.

2.5 MORTAR MIXES

A. Comply with requirements in Section 042000 "Unit Masonry" for mortar mixes.

2.6 SOURCE QUALITY CONTROL

A. Engage a qualified independent testing agency to sample and test cast stone units according to ASTM C1364.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SETTING CAST STONE IN MORTAR

A. Set cast stone as indicated in TMS 604.

B. Install cast stone units to comply with requirements in Section 042000 "Unit Masonry."

C. Provide sealant joints at head joints of copings and other horizontal surfaces; at expansion, control, and pressure-relieving joints; and at locations indicated.

1. Keep joints free of mortar and other rigid materials.
2. Build in compressible foam-plastic joint fillers where indicated.
3. Form joint of width indicated, but not less than 3/8 inch.
4. Prime cast stone surfaces to receive sealant and install compressible backer rod in joints before applying sealant unless otherwise indicated.
5. Prepare and apply sealant of type and at locations indicated to comply with applicable requirements in Section 079200 "Joint Sealants."

3.3 FIELD QUALITY CONTROL

A. Test one randomly selected sample from the field for each 500 cubic feet delivered to the job site. Verify compliance with the following:

1. Three field cut cube specimens from each of these samples shall have an average minimum compressive strength of not less than 85 percent with no single specimen testing less than 75 percent of design strength as allowed by ACI 318.
2. Three field cut cube specimens from each of these samples shall have an average maximum cold-water absorption of 6 percent.

B. Architect Inspection: Architect will inspect installed masonry and reject masonry that is chipped, cracked, or blemished (streaked, stained or otherwise damaged), as described below.

1. Masonry will be inspected to be free of chips, cracks or other blemishes on the finished face or front edges of the masonry units exceeding 3/8 inch or that can be seen from a distance of 10 feet.
2. Units shall exhibit a texture approximately equal to the approved sample when viewed under direct daylight illumination at a 10 feet distance.
3. Minor chipping resulting from shipment and delivery shall not be grounds for rejection. Minor chips shall not be obvious under direct daylight illumination from a 20 feet distance.
4. Crazing and efflorescence will not be cause for rejection.

C. Replace cast stone masonry that fails tests and inspections.

D. Prepare and submit field quality control reports for tests performed.

3.4 ADJUSTING AND CLEANING

A. Remove and replace stained and otherwise damaged units and units not matching approved Samples. Cast stone may be repaired if methods and results are approved by Architect.

B. Replace units in a manner that results in cast stone matching approved Samples, complying with other requirements, and showing no evidence of replacement.

C. Cleaning: As specified in Section 042000 “Unit Masonry.”

3.5 PROTECTION

A. Protect units from damage resulting from subsequent construction operations.

B. Use protection materials and methods which will not stain or damage units.

C. Remove protection materials upon Substantial Completion, or when risk of damage is no longer present.

END OF SECTION 047200

SECTION 051200 - STRUCTURAL STEEL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes

1. Structural steel framing members, support members and suspension cables.
2. Structural steel support members and suspension cables.
3. Base plates, shear stud connectors.
4. Grouting under base plates.

1.3 RELATED REQUIREMENTS

A. Section 052100 - Steel Joist Framing.

B. Section 053100 - Steel Decking: Support framing for small openings in deck.

C. Section 055000 - Metal Fabrications: Steel fabrications affecting structural steel work.

1.4 REFERENCE STANDARDS

A. AISC (MAN) - Steel Construction Manual; 2017.

B. AISC 303 - Code of Standard Practice for Steel Buildings and Bridges; 2016.

C. ASTM A325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength; 2014.

D. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.

E. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2018.

F. ASTM A108 - Standard Specification for Steel Bar, Carbon and Alloy, Cold Finished; 2018.

G. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.

H. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength; 2014 (Editorial 2017).

I. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2013.

J. ASTM A501/A501M - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing; 2014.

K. ASTM A514/A514M - Standard Specification for High-Yield-Strength, Quenched and Tempered Alloy Steel Plate, Suitable for Welding; 2014.

L. ASTM A563 - Standard Specification for Carbon and Alloy Steel Nuts; 2015.

M. ASTM A563M - Standard Specification for Carbon and Alloy Steel Nuts (Metric); 2007 (Reapproved 2013).

N. ASTM A572/A572M - Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel; 2015.

O. ASTM A992/A992M - Standard Specification for Structural Steel Shapes; 2011 (Reapproved 2015).

P. ASTM A1008/A1008M - 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; 2018.

Q. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2018a.

R. ASTM C827/C827M - Standard Test Method for Change in Height at Early Ages of Cylindrical Specimens of Cementitious Mixtures; 2016.

S. ASTM E94/E94M - Standard Guide for Radiographic Examination Using Industrial Radiographic Film; 2017.

T. ASTM E94 - Standard Guide for Radiographic Examination; 2004 (Reapproved 2010).

U. ASTM E164 - Standard Practice for Contact Ultrasonic Testing of Weldments; 2013.

V. ASTM E165/E165M - Standard Test Method for Liquid Penetrant Examination for General Industry; 2012.

W. ASTM E709 - Standard Guide for Magnetic Particle Testing; 2015.

X. ASTM F1852 - Standard Specification for "Twist Off" Type Tension Control Structural Bolt/Nut/Washer Assemblies, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength; 2011.

Y. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi (830 MPa) and 150 ksi (1040 MPa) Minimum Tensile Strength, Inch and Metric Dimensions; 2015a.

Z. ASTM F436/F436M - Standard Specification for Hardened Steel Washers Inch and Metric Dimensions; 2018a.

AA. ASTM F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength; 2018.

BB. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; 2012.

CC. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2015, with Errata (2016).

DD. IAS AC172 - Accreditation Criteria for Fabricator Inspection Programs for Structural Steel; 2017.

EE. RCSC (HSBOLT) - Specification for Structural Joints Using High-Strength Bolts; Research Council on Structural Connections; 2014, with Errata (2015).

FF. SSPC-SP 3 - Power Tool Cleaning; 1982, with Editorial Revision (2004).

GG. UL (FRD) - Fire Resistance Directory; Current Edition.

1.5 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Shop Drawings:

1. Indicate profiles, sizes, spacing, locations of structural members, openings, attachments, and fasteners.
2. Connections not detailed.
3. Indicate cambers and loads.
4. Indicate welded connections with AWS A2.4 welding symbols. Indicate net weld lengths.

C. Manufacturer's Mill Certificate: Certify that products meet or exceed specified requirements.

D. Fabricator Test Reports: Comply with ASTM A1011/A1011M.

E. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within the previous 12 months.

F. Designer's Qualification Statement.

G. Fabricator's Qualification Statement: Provide documentation showing steel fabricator is accredited under IAS AC172.

1.6 QUALITY ASSURANCE

A. Fabricate structural steel members in accordance with AISC (MAN) "Steel Construction Manual."

B. Maintain one copy of each document on site.

C. Fabricator: Company specializing in performing the work of this section with minimum 5 years of documented experience.

D. Fabricator Qualifications: A qualified steel fabricator that is accredited by the International Accreditation Service (IAS) Fabricator Inspection Program for Structural Steel in accordance with IAS AC172.

E. Erector: Company specializing in performing the work of this section with a minimum of 5 years of documented experience.

F. Design connections not detailed on drawings under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located.

PART 2 - PRODUCTS

2.1 REGULATORY REQUIREMENTS

A. Comply with UL (FRD) Assembly Design No. as indicated on drawings.

2.2 MATERIALS

A. Steel Angles and Plates: ASTM A36/A36M.

B. Steel W Shapes and Tees: ASTM A992/A992M.

C. Rolled Steel Structural Shapes: ASTM A992/A992M.

D. Cold-Formed Structural Tubing: ASTM A500/A500M, Grade B or C.

E. Hot-Formed Structural Tubing: ASTM A501/A501M, seamless or welded.

F. Steel Sheet: ASTM A1011/A1011M, Designation SS, Grade 30 hot-rolled, or ASTM A1008/A1008M, Designation SS, Grade 30 cold-rolled.

G. Pipe: ASTM A53/A53M, Grade B, Finish black.

H. Shear Stud Connectors: Made from ASTM A108 Grade 1015 bars.

I. Structural Bolts and Nuts: Carbon steel, ASTM A307, Grade A and galvanized in compliance with ASTM A153/A153M, Class C.

J. High-Strength Structural Bolts, Nuts, and Washers: ASTM A325, ASTM F1852, ASTM F3125/F3125M, Type 1, with matching compatible ASTM A563 or ASTM A563M nuts and ASTM F436/F436M washers.

K. Tension Control Bolts: Twist-off type; ASTM F3125/F3125M.

L. Unheaded Anchor Rods: Unless noted otherwise on the structural drawings provide: ASTM F1554, Grade 36, plain, with matching ASTM A563 or ASTM A563M nuts and ASTM F436/F436M Type 1 washers.

M. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.

N. Grout: ASTM C1107/C1107M; Non-shrink; premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents.

1. Minimum Compressive Strength at 48 Hours: 2,000 pounds per square inch.
2. Minimum Compressive Strength at 28 Days: 5,000 pounds per square inch.
3. Height Change, Plastic State; when tested according to ASTM C827/C827M:

a. Maximum: Plus 4 percent.
b. Minimum: Plus 1 percent.

O. Shop and Touch-Up Primer: Fabricator's standard, complying with VOC limitations of authorities having jurisdiction.

2.3 FABRICATION

A. Shop fabricate to greatest extent possible.

B. Continuously seal joined members by continuous welds. Grind exposed welds smooth.

C. Fabricate connections for bolt, nut, and washer connectors.

D. Develop required camber for members.

E. General: Fabricate structural steel in accordance with referenced specifications.

1. Drawings indicate the design, sections and weights of members. Make no substitutions except with the written permission of the Architect. Do not use dimensions scaled from the drawings for fabrication. Contractor shall, when necessary, determine actual dimensions at the building.
2. Workmanship shall conform to the best practice in structural steel shops. Materials shall be clean and straight. Shop kinks will not be permitted.
3. Exposed steel, where in view, shall meet the requirements of the AISC Manual for "Architecturally Exposed Structural Steel."

F. Connections shall conform to the standard specifications of the American Institute of Steel Construction.

G. Punching: Shop-punch steel members for bolts and hanger rods needed to support wood nailers and other items.

H. Marking: Components of high strength steel required to have a yield stress greater than 36 kips/sq. in. shall be clearly marked with the ASTM designation over any shop coat prior to shipment from the fabricator's plant.

I. Shop Painting:

1. Do not paint steel surfaces to be welded, including top flange of steel beams that are to receive shear studs. Do not paint steel surfaces which are scheduled to receive sprayed-on fireproofing. Clean this steelwork of oil and grease with solvent cleaner and remove dirt and other foreign matter by sweeping with brushes or with compressed air.
2. Apply one coat of shop paint to steel. Prior to application of shop paint clean steel to remove loose mill scale, rust, weld slag, dirt, and other foreign matter. Clean welds of spatter, smoke, and iron oxide film. Remove oil and grease with solvent cleaner
3. Apply shop paint to dry surfaces thoroughly and evenly by brush, spray, roller coating, or dipping at the election of the fabricator.

2.4 FINISH

A. Prepare structural component surfaces in accordance with SSPC-SP 3.

B. Shop prime structural steel members. Do not prime surfaces that will be fireproofed, field welded, in contact with concrete, or high strength bolted.

2.5 SOURCE QUALITY CONTROL

A. Provide shop testing and analysis of structural steel.

1. Percentage Tested: 10 percent.

B. High-Strength Bolts: Provide testing and verification of shop-bolted connections in accordance with RCSC (HSBOLT) "Specification for Structural Joints Using High-Strength Bolts", testing at least 10 percent of bolts at each connection.

C. Welded Connections: Visually inspect all shop-welded connections and test at least 10 percent of welds using one of the following:

1. Radiographic testing performed in accordance with ASTM E94/E94M.
2. Ultrasonic testing performed in accordance with ASTM E164.
3. Liquid penetrant inspection performed in accordance with ASTM E165/E165M.
4. Magnetic particle inspection performed in accordance with ASTM E709.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that conditions are appropriate for erection of structural steel and that the work may properly proceed.

3.2 ERECTION

A. Erect structural steel in compliance with AISC 303.

B. Allow for erection loads and provide sufficient temporary bracing to maintain structure in safe condition, plumb, and in true alignment until completion of erection and installation of permanent bracing.

C. Field weld components and shear studs indicated on shop drawings.

D. Use carbon steel bolts only for temporary bracing during construction, unless otherwise specifically permitted on drawings. Install high-strength bolts in accordance with RCSC (HSBOLT) "Specification for Structural Joints Using High-Strength Bolts".

E. Do not field cut or alter structural members without approval of Architect.

F. After erection, prime welds, abrasions, and surfaces not shop primed or galvanized, except surfaces to be in contact with concrete.

G. Grout solidly between column plates and bearing surfaces, complying with manufacturer's instructions for non-shrink grout. Trowel grouted surfaces smooth, splaying neatly to 45 degrees.

3.3 TOLERANCES

A. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.

B. Maximum Offset From True Alignment: 1/4 inch.

3.4 FIELD QUALITY CONTROL

A. An independent testing agency will perform field quality control tests, as specified in Section 014000 - Quality Requirements.

B. High-Strength Bolts: Provide testing and verification of field-bolted connections in accordance with RCSC (HSBOLT) "Specification for Structural Joints Using High-Strength Bolts", testing at least 10 percent of bolts at each connection.

C. Welded Connections: Visually inspect all field-welded connections and test at least 10 percent of welds using one of the following:

1. Radiographic testing performed in accordance with ASTM E94/E94M.
2. Ultrasonic testing performed in accordance with ASTM E164.
3. Liquid penetrant inspection performed in accordance with ASTM E165/E165M.
4. Magnetic particle inspection performed in accordance with ASTM E709.

D. Inspection and Testing: Verification inspection and testing of all field connections shall be done by an Independent Testing Laboratory, and copies of the inspection and test reports shall be submitted to the Architect and Contractor. The cost of these inspections and tests shall be paid as specified in SECTION 014523 - TESTING AND INSPECTION SERVICES.

E. High-Strength Bolted Connections: All bolted connections shall be visually inspected in accordance with manufacturer's specifications.

F. Welded Connections:

1. All welds that fail ultrasonic test shall be re-welded and re-tested until they pass the test.

END OF SECTION 051200

SECTION 053100 – STEEL DECKING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes

1. Roof deck.
2. Supplementary framing for openings up to and including 18 inches.
3. Bearing plates and angles.

B. RELATED REQUIREMENTS

1. Section 051200 - Structural Steel: Support framing for openings larger than 18 inches and shear stud connectors.
2. Section 051200 - Structural Steel: Placement of embedded steel anchors for bearing plates in cast-in-place concrete.
3. Section 052100 - Steel Joist Framing: Support framing for openings larger than 18 inches and shear stud connectors.
4. Section 052100 - Steel Joist Framing: Placement of embedded steel anchors for bearing plates and joist seats in cast-in-place concrete.
5. Section 055000 - Metal Fabrications: Steel angle concrete stops at deck edges.

1.3 REFERENCE STANDARDS

A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.

B. ASTM A108 - Standard Specification for Steel Bar, Carbon and Alloy, Cold Finished; 2018.

C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2017.

D. ASTM A1008/A1008M - 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; 2018.

E. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2015.

F. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2015, with Errata (2016).

G. AWS D1.3/D1.3M - Structural Welding Code - Sheet Steel; 2018.

H. IAS AC172 - Accreditation Criteria for Fabricator Inspection Programs for Structural Steel; 2017.

I. ICC-ES AC43 - Acceptance Criteria for Steel Deck Roof and Floor Systems; 2016.

J. SDI (DM) - Publication No.30, Design Manual for Composite Decks, Form Decks, and Roof Decks; 2007.

K. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer; 1999 (Ed. 2004).

L. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic"); 2002 (Ed. 2004).

M. SSPC-Paint 25 - Zinc Oxide, Alkyd, Linseed Oil Primer for Use Over Hand Cleaned Steel, Type I and Type II; Society for Protective Coatings; 1997 (Ed. 2004).

N. UL (FRD) - Fire Resistance Directory; Current Edition.

1.4 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittals procedures.

B. Product Data: Provide deck profile characteristics, dimensions, structural properties, and finishes.

C. Shop Drawings: Indicate deck plan, support locations, projections, openings, reinforcement, pertinent details, and accessories.

D. Certificates: Certify that products furnished meet or exceed specified requirements.

E. Submit manufacturer's installation instructions.

F. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within the previous 12 months.

G. Fabricator's Qualification Statement: Provide documentation showing steel fabricator is accredited under IAS AC172.

1.5 QUALITY ASSURANCE

A. Design deck layout, spans, fastening, and joints under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located.

B. Fabricator Qualifications: A qualified steel fabricator that is accredited by the International Accreditation Service (IAS) Fabricator Inspection Program for Structural Steel in accordance with IAS AC172.

C. Installer Qualifications: Company specializing in performing the work of this Section with a minimum of 3 years of experience.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Steel Deck:

1. Canam Steel Corporation: www.canam-steeljoists.ws.
2. Cordeck, Inc: www.cordeck.com/#sle.
3. Nucor-Vulcraft Group: www.vulcraft.com/#sle.
4. Wheeling Corrugating Co: www.wheelingcorrugating.com.
5. New Millennium. www.newmill.com.
6. Substitutions: See Section 016000 - Product Requirements.

2.2 STEEL DECK

A. All Deck Types: Select and design metal deck in accordance with SDI Design Manual.

1. Calculate to structural working stress design and structural properties specified.
2. Maximum Vertical Deflection of Floor Deck: 1/360 of span.
3. Maximum Vertical Deflection of Roof Deck: 1/240 of span.
4. Maximum Vertical Deflection of Form Deck: 1/360 of span.
5. Maximum Lateral Deflection of Diaphragms: 1/500 of the height of the wall.

B. Roof Deck: Non-composite type, fluted steel sheet:

1. Galvanized Steel Sheet: ASTM A653/A653M, Structural Steel (SS) Grade 33/230, with G90/Z275 galvanized coating.
2. Primer: Shop coat of manufacturer's standard primer paint over cleaned and phosphatized substrate.
3. Structural Properties:

    a. Span Design: Double Minimum.

4. Minimum Base Metal Thickness: 22 gage, 0.0299 inch.
5. Nominal Height:1-1/2 inch.
6. Profile: Fluted; SDI B.
7. Formed Sheet Width: 36 inch.
8. Side Joints: Lapped, mechanically fastened.
9. End Joints: Lapped, welded or mechanically fastened.
10. Fire Resistance Classification: Comply with UL (FRD) Assembly Number as indicated on drawings.

2.3 ACCESSORY MATERIALS

A. Bearing Plates and Angles: ASTM A36/A36M steel, unfinished.

B. Welding Materials: AWS D1.1/D1.1M.

C. Fasteners: Galvanized hardened steel, self-tapping.

D. Mechanical Fasteners: Steel; hex washer head, self-drilling, self-tapping.

1. Design Requirements for Sidelap Connections: Provide number and type of fasteners that comply with the applicable requirements of SDI (DM)SDI design method for roof deck and floor deck applications and ICC-ES AC43.
2. Fasteners for Steel Roof Decks Protected with Waterproofing Membrane: ASTM B633, SC1, Type III zinc electroplate.
3. Fasteners for Exposed Steel Roof Deck Application: Manufacturer's standard stainless steel with bonded neoprene washer.
4. Products:

    a. ITW Commercial Construction North America; ITW CCNA-Buildex Teks Select Series: www.ITWBuildex.com/#sle.
    b. Substitutions: See Section 016000 - Product Requirements.

E. Weld Washers: Mild steel, uncoated, 3/4 inch outside diameter, 1/8 inch thick.

F. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.

G. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, complying with VOC limitations of authorities having jurisdiction.

H. Flute Closures: Closed cell foam rubber, 1 inch thick; profiled to fit tight to the deck.

2.4 FINISH FABRICATED DECK ACCESSORIES

A. Sheet Metal Deck Accessories: Metal closure strips, wet concrete stops, and cover plates, 22 gage, 0.0299-inch-thick sheet steel; of profile and size as indicated; finished same as deck.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify existing conditions prior to beginning work.

3.2 INSTALLATION

A. Erect metal deck in accordance with SDI Design Manual and manufacturer's instructions. Align and level.

B. On steel supports provide a minimum 1-1/2-inch bearing.

C. Fasten deck to steel support members at ends and intermediate supports as indicated on the structural drawings.

D. At male/female side laps attach as indicated on drawings.

E. Drive mechanical sidelap connectors completely through adjacent lapped sheets; positively engage adjacent sheets with minimum three-thread penetration.

F. Weld deck in accordance with AWS D1.3/D1.3M.

G. Where deck (other than cellular deck electrical raceway) changes direction, install 6-inch minimum wide sheet steel cover plates, of same thickness as deck. Fusion weld 12 inches on center maximum.

H. At openings between deck and walls, columns, and openings, provide sheet steel closures and angle flashings to close openings.

I. Close openings above walls and partitions perpendicular to deck flutes with single row of foam cell closures.

J. Place metal cant strips in position and fusion weld.

K. Position roof drain pans with flange bearing on top surface of deck. Fusion weld at each deck flute.

L. Immediately after welding deck and other metal components in position, coat welds, burned areas, and damaged surface coating, with touch-up primer.

END OF SECTION 053100

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SECTION 054000 – 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

1. Formed steel stud exterior wall and interior wall framing.
2. Formed steel joist and purlin framing and bridging.

1.3 RELATED REQUIREMENTS

A. Section 072100 - Thermal Insulation: Insulation within framing members.

B. Section 076200 - Sheet Metal Flashing and Trim: Head and sill flashings.

C. Section 079200 - Joint Sealants.

D. Section 092116 - Gypsum Board Assemblies: Gypsum-based sheathing.

1.4 REFERENCE STANDARDS

A. AISI S100-12 - North American Specification for the Design of Cold-Formed Steel Structural Members; American Iron and Steel Institute; 2012.

B. AISI SG02-1 - North American Specification for the Design of Cold-Formed Steel Structural Members; American Iron and Steel Institute; 2001 with 2004 supplement. (replaced SG-971)

C. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.

D. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2017.

E. ASTM A1008/A1008M - 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; 2018.

F. ASTM C955 - Standard Specification for Cold-Formed Steel Structural Framing Members; 2018.

G. ASTM C1007 - Standard Specification for Installation of Load Bearing (Transverse and Axial) Steel Studs and Related Accessories; 2011a (Reapproved 2015).

H. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2015, with Errata (2016).

I. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer; 1999 (Ed. 2004).

J. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic"); 2002 (Ed. 2004).

1.5 ADMINISTRATIVE REQUIREMENTS

A. Coordinate with work of other sections that is to be installed in or adjacent to the metal framing system, including but not limited to structural anchors, cladding anchors, utilities, insulation, and firestopping.

1.6 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide data on standard framing members; describe materials and finish, product criteria, limitations.

C. Product Data: Provide manufacturer's data on factory-made framing connectors, showing compliance with requirements.

D. Shop Drawings: Indicate component details, framed openings, bearing, anchorage, loading, welds, and type and location of fasteners, and accessories or items required of related work.

1. Indicate stud and ceiling joist layout.
2. Describe method for securing studs to tracks and for screw framing connections.
3. Shop drawings signed and sealed by a professional structural engineer.
4. Calculations for loadings and stresses of specially fabricated framing and other items on the drawings, signed and sealed by a professional structural engineer.
5. Details and calculations for factory-made framing connectors, signed and sealed by a professional structural engineer.

E. Manufacturer's Installation Instructions: Indicate special procedures, conditions requiring special attention, and details.

F. Designer's Qualification Statement.

G. Manufacturer's Qualification Statement.

1.7 QUALITY ASSURANCE

A. Designer Qualifications: Design framing system under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located.

B. Manufacturer Qualifications: Company specializing in manufacturing the types of products specified in this section, and with minimum three years of documented experience.

C. Installer Qualifications: Company specializing in performing the work of this section with minimum three years documented experience.

1.8 MOCK-UP

A. Provide mock-up of exterior framed wall, including components specified elsewhere, such as insulation, sheathing, window frame, door frame, exterior wall finish, interior wall finish, and masonry veneer.

B. Refer to 04 20 01- Masonry Veneer for Mock-Up requirements.

C. Mock-up may remain as part of the Work.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Metal Framing:

1. CEMCO: www.cemcosteel.com/#sle.
2. ClarkDietrich Building Systems: www.clarkdietrich.com/#sle.
3. Jaimes Industries: www.jaimesind.com/#sle.
4. Marino: www.marinoware.com/#sle.
5. Steel Construction Systems: www.steelconsystems.com/#sle.
6. SCAFCO Corporation: www.scafco.com/#sle.
7. The Steel Network, Inc: www.SteelNetwork.com/#sle.
8. Substitutions: See Section 016000 - Product Requirements.

B. Framing Connectors and Accessories:

1. Same manufacturer as metal framing.

2.2 FRAMING SYSTEM

A. Provide primary and secondary framing members, bridging, bracing, plates, gussets, clips, fittings, reinforcement, and fastenings as required to provide a complete framing system.

B. Design Requirements: Provide completed framing system having the following characteristics:

1. Design: Calculate structural characteristics of cold-formed steel framing members according to AISI S100-12.
2. Structural Performance: Design, engineer, fabricate, and erect to withstand specified design loads for project conditions within required limits.
3. Design Loads: As indicated on structural drawings
4. Live load deflection meeting the following, unless otherwise indicated:

    a. Roofs: Maximum vertical deflection under live load of 1/240 of span.
    b. Exterior Walls with Metal Panels: Maximum horizontal deflection under wind load of 1/240 of span.
    c. Exterior Walls with EIFS/Stucco: Maximum horizontal deflection under wind load of 1/360 of span.
    d. Exterior Walls with Masonry Veneer: Maximum horizontal deflection under wind load of 1/600 of span. If stud span for 6" and 8" 18 gage stud exceed L/600, either increase stud gage, decrease stud spacing, or add light-gage bracing to control deflection to L/600. Light gage bracing shall remain above architectural ceiling line.
    e. Design non-axial loadbearing framing to accommodate not less than 1/2 in vertical deflection.

5. Able to tolerate movement of components without damage, failure of joint seals, undue stress on fasteners, or other detrimental effects when subject to seasonal or cyclic day/night temperature ranges.
6. Able to accommodate construction tolerances, deflection of building structural members, and clearances of intended openings.

C. Shop fabricate framing system to the greatest extent possible.

D. Deliver to project site in largest practical sections.

2.3 FRAMING MATERIALS

A. Studs and Track: ASTM C955; studs formed to channel, C- or Sigma-shaped with punched web; U-shaped track in matching nominal width and compatible height.

1. Gage and Depth: As required to meet specified performance levels.
2. Galvanized in accordance with ASTM A653/A653M, G90/Z275 coating.
3. Provide components fabricated from ASTM A1008/A1008M, Designation SS (structural steel).

B. Joists and Purlins: Fabricated from ASTM A653/A653M steel sheet, with G90/Z275 hot dipped galvanized coating.

1. Base Metal: Structural Steel (SS), Grade 33/230.
2. Gage and Depth: As required to meet specified performance levels.

C. Framing Connectors: Factory-made, formed steel sheet.

1. Material: ASTM A653/A653M SS Grade 33 and 40 (minimum), with G90/Z275 hot dipped galvanized coating for base metal thickness less than 10 gage, 0.1345 inch, and factory punched holes and slots.
2. Structural Performance: Maintain load and movement capacity required by applicable code, when evaluated in accordance with AISI S100-12.
3. Movement Connections: Provide mechanical anchorage devices that accommodate movement using slotted holes, shouldered screws or screws and anti-friction or stepped bushings, while maintaining structural performance of framing. Provide movement connections where indicated on drawings.

    a. Where continuous studs bypass elevated floor slab, connect stud to slab in manner allowing vertical and horizontal movement of slab without affecting studs; allow for minimum movement of 1/2 inch.
    b. Where top of stud wall terminates below structural floor or roof, connect studs to structure in manner allowing vertical and horizontal movement of slab without affecting studs; allow for minimum movement of 1/2 inch.
    c. Provide top track preassembled with connection devices spaced to fit stud spacing indicated on drawings; minimum track length of 10 feet.

4. Fixed Connections: Provide non-movement connections for tie-down to foundation, floor-to-floor tie-down, roof-to-wall tie-down, joist hangers, gusset plates, and stiffeners.
5. Wall Stud Bridging Connections: Provide mechanical load-transferring devices that accommodate wind load torsion and weak axis buckling induced by axial compression loads. Provide bridging connections where indicated on the drawings.

2.4 FASTENERS

A. Self-Drilling, Self-Tapping Screws, Bolts, Nuts and Washers: Hot dip galvanized per ASTM A153/A153M.

1. Products:

    a. ITW Commercial Construction North America; ITW CCNA-Buildex Teks Select Series: www.ITWBuildex.com/#sle.
    b. Substitutions: See Section 016000 - Product Requirements.

B. Anchorage Devices: Powder actuated, Drilled expansion bolts, and Screws with sleeves.

C. Welding: Comply with AWS D1.1/D1.1M.

2.5 ACCESSORIES

A. Bracing, Furring, Bridging: Formed sheet steel, thickness determined for conditions encountered; finish to match framing components.

B. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.

C. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.

D. Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch thick, selected from manufacturer's standard widths to match width of bottom track or rim track members as required.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that substrate surfaces are ready to receive work.

B. Verify field measurements and adjust installation as required.

3.2 INSTALLATION OF STUDS

A. Install components in accordance with manufacturers' instructions and ASTM C1007 requirements.

B. Align floor and ceiling tracks; locate to wall layout. Secure in place with fasteners at maximum 24 inches on center. Coordinate installation of sealant with floor and ceiling tracks.

C. Place studs at 16 inches on center; not more than 2 inches from abutting walls and at each side of openings. Connect studs to tracks using fastener method.

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.

E. Provide vertical stud within 12 inches of jamb for brick anchor attachment at openings. Reference BIA Technical Note 28B.

F. Construct corners using minimum of three studs. Install double studs at wall openings, door and window jambs.

G. Install load-bearing studs full length in one piece. Splicing of studs is not permitted.

H. Install load-bearing studs, brace, and reinforce to develop full strength and achieve design requirements.

I. Coordinate placement of insulation in multiple stud spaces made inaccessible after erection.

J. Install intermediate studs above and below openings to align with wall stud spacing.

K. Provide deflection allowance in stud track, directly below horizontal building framing at non-load bearing framing.

L. Attach cross studs to studs for attachment of fixtures anchored to walls.

M. Install framing between studs for attachment of mechanical and electrical items, and to prevent stud rotation. Provide rows of horizontal bridging welded in place at spacing recommended by stud manufacturer to resist lateral forces and stud rotation.

N. Touch-up field welds and damaged galvanized surfaces with primer.

3.3 INSTALLATION OF JOISTS AND PURLINS

A. Install framing components in accordance with manufacturer's instructions.

B. Make provisions for erection stresses. Provide temporary alignment and bracing.

C. Place joists at 16 inches on center; not more than 2 inches from abutting walls, and connect joists to supports using fastener method.

D. Set floor and ceiling joists parallel and level, with lateral bracing and bridging.

E. Locate joist end bearing directly over load-bearing studs or provide load distributing member to top of stud track.

F. Provide web stiffeners at reaction points.

G. Touch-up field welds and damaged galvanized surfaces with primer.

3.4 TOLERANCES

A. Maximum Variation from True Position: 1/8 inch.

B. Maximum Variation of any Member from Plane: 1/8 inch.

END OF SECTION 054000

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SECTION 055000 - METAL FABRICATIONS

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. Steel framing and supports for mechanical and electrical equipment.
2. Steel framing and supports for applications where framing and supports are not specified in other Sections.
3. Shelf angles.
4. Metal ships' ladders.
5. Loose bearing and leveling plates for applications where they are not specified in other Sections.

B. Products furnished, but not installed, under this Section include the following:

1. Loose steel lintels.
2. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.
3. Steel weld plates and angles for casting into concrete for applications where they are not specified in other Sections.

C. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for installing anchor bolts, steel pipe sleeves, slotted-channel inserts, wedge-type inserts, and other items cast into concrete.
2. Section 042000 "Unit Masonry" for installing loose lintels, anchor bolts, and other items built into unit masonry.
3. Section 051200 "Structural Steel Framing" for steel framing, supports, elevator machine beams, hoist beams, divider beams, door frames, and other steel items attached to the structural-steel framing.

1.3 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of metal fabrications that are anchored to or that receive other work. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.4 ACTION SUBMITTALS

A. Product Data: For the following:

1. Nonslip aggregates and nonslip-aggregate surface finishes.
2. Grout.
3. Paint products.

B. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.

1.5 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel in accordance with the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.7 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls, floor slabs, decks, and other construction contiguous with metal fabrications by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design ships' ladders.

B. Structural Performance of Ships' Ladders: Shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Uniform Load: 100 lbf/sq. ft..
2. Concentrated Load: 300 lbf in accordance with Section 4.5.4 of ASCE 7.
3. Uniform and concentrated loads need not be assumed to act concurrently.
4. Ship's Ladder Framing: Capable of withstanding stresses resulting from railing loads in addition to loads specified above.
5. Comply with applicable railing loadings in Section 055213 "Pipe and Tube Railings."

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 METALS

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

B. Steel Plates, Shapes, and Bars: ASTM A36/A36M.

C. Steel Tubing: ASTM A500/A500M, cold-formed steel tubing.

D. Steel Pipe: ASTM A53/A53M, Standard Weight (Schedule 40) unless otherwise indicated.

E. Slotted Channel Framing: Cold-formed metal box channels (struts) complying with MFMA-4.

1. Size of Channels: 1-5/8 by 1-5/8 inches
2. Material: Cold-rolled steel, ASTM A1008/A1008M, structural steel, Grade 33; 0.0677-inch minimum thickness; coated with rust-inhibitive, baked-on, acrylic enamel

2.3 FASTENERS

A. General: Unless otherwise indicated, provide Type 304stainless steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.

1. Provide stainless steel fasteners for fastening stainless steel or nickel silver.

B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A307, Grade A; with hex nuts, ASTM A563; and, where indicated, flat washers.

C. High-Strength Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325, Type 3, heavy-hex steel structural bolts; ASTM A563, Grade DH3, heavy-hex carbon-steel nuts; and where indicated, flat washers.

D. Stainless Steel Bolts and Nuts: Regular hexagon-head annealed stainless steel bolts, ASTM F593; with hex nuts, ASTM F594; and, where indicated, flat washers; AlloyGroup 1

E. Anchor Bolts: ASTM F1554, Grade 36, of dimensions indicated; with nuts, ASTM A563; and, where indicated, flat washers.

1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.

F. Anchors, General: Capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing in accordance with ASTM E488/E488M, conducted by a qualified independent testing agency.

G. Cast-in-Place Anchors in Concrete: Either threaded or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A47/A47M malleable iron or ASTM A27/A27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F2329/F2329M.

H. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors.

1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.
2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 stainless steel bolts, ASTM F593, and nuts, ASTM F594.

I. Slotted-Channel Inserts: Cold-formed, hot-dip galvanized-steel box channels (struts) complying with MFMA-4, 1-5/8 by 7/8 inches by length indicated with anchor straps or studs not less than 3 inches long at not more than 8 inches o.c. Provide with temporary filler and tee-head bolts, complete with washers and nuts, all zinc-plated to comply with ASTM B633, Class Fe/Zn 5, as needed for fastening to inserts.

2.4 MISCELLANEOUS MATERIALS

A. Shop Primers: Provide primers that comply with Section 099123 "Interior Painting." and Section 099600 "High-Performance Coatings."

B. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

C. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

D. Shrinkage-Resistant Grout: Factory-packaged, nonmetallic, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

E. Concrete: Comply with requirements in Section 033000 "Cast-in-Place Concrete" for normal-weight, air-entrained concrete with a minimum 28-day compressive strength of 3000 psi.

2.5 FABRICATION, GENERAL

A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

D. Form exposed work with accurate angles and surfaces and straight edges.

E. Weld corners and seams continuously to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.

G. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

J. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches, with a minimum 6-inch embedment and 2-inch hook, not less than 8 inches from ends and corners of units and 24 inches o.c., unless otherwise indicated.

2.6 MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.

B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.

1. Fabricate units from slotted channel framing where indicated.
2. Furnish inserts for units installed after concrete is placed.

C. Galvanize miscellaneous framing and supports where indicated.

2.7 SHELF ANGLES

A. Fabricate shelf angles from steel angles of sizes indicated and for attachment to CMU. Provide horizontally slotted holes to receive 3/4-inch bolts, spaced not more than 6 inches from ends and 24 inches o.c., unless otherwise indicated.

1. Provide mitered and welded units at corners.
2. Provide open joints in shelf angles at expansion and control joints. Make open joint approximately 2 inches larger than expansion or control joint.

B. Galvanize shelf angles located in exterior walls.

2.8 METAL SHIPS' LADDERS

A. Provide metal ships' ladders where indicated. Fabricate of open-type construction with channel or plate stringers and pipe and tube railings unless otherwise indicated. Provide brackets and fittings for installation.

1. Treads shall be not less than 5 inches exclusive of nosing or less than 8-1/2 inches including the nosing, and riser height shall be not more than 9-1/2 inches.
2. Fabricate ships' ladders, including railings from steel.
3. Fabricate treads and platforms from abrasive-surface floor plate. Fabricate risers from rolled steel floor plate or 14 gauge steel riser pans.
4. Comply with applicable railing requirements in Section 055213 "Pipe and Tube Railings."

B. Prime steel ships' ladders, including treads, railings, brackets, and fasteners, with zinc-rich primer. primer specified in Section 099123 "Interior Painting."

2.9 MISCELLANEOUS STEEL TRIM

A. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.

B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.

1. Provide with integrally welded steel strap anchors for embedding in concrete or masonry construction.

C. Galvanize exterior miscellaneous steel trim.

2.10 LOOSE BEARING AND LEVELING PLATES

A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.

B. Galvanize bearing and leveling plates.

2.11 LOOSE STEEL LINTELS

A. Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated on Drawings. Fabricate in single lengths for each opening unless otherwise indicated. Weld adjoining members together to form a single unit where indicated.

B. Size loose lintels to provide bearing length at each side of openings as shown on Structural Drawings..

C. Galvanize loose steel lintels located in exterior walls.

2.12 STEEL WELD PLATES AND ANGLES

A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel strap anchors for embedding in concrete.

2.13 GENERAL FINISH REQUIREMENTS

A. Finish metal fabrications after assembly.

B. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.14 STEEL AND IRON FINISHES

A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A153/A153M for steel and iron hardware and with ASTM A123/A123M for other steel and iron products.

1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.

B. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.

1. Shop prime with primers specified in Section 099123 "Interior Painting"
2. Galvanized items to be primed in the field per Section 099600 “High Performance Coatings.”

C. Preparation for Shop Priming: Prepare surfaces to comply with requirements indicated below:

1. Exterior Items: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
2. Other Steel Items: SSPC-SP 3, "Power Tool Cleaning."

D. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

C. Field Welding: Comply with the following requirements:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.

E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

3.2 INSTALLATION OF MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.

B. Anchor supports for overhead doors securely to, and rigidly brace from, building structure.

3.3 INSTALLATION OF BEARING AND LEVELING PLATES

A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.

B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with shrinkage-resistant grout. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.4 REPAIRS

A. Touchup Painting:

1. Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 099123 "Interior Painting."

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780/A780M.

END OF SECTION 055000

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SECTION 055213 - PIPE AND TUBE RAILINGS

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. Steel pipe and tube railings.

B. Related Requirements:

1. Section 055000 “Metal Fabrications” for steel tube railings associated with ships’ ladders.

1.3 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

C. Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not satisfy structural performance requirements.

1.4 ACTION SUBMITTALS

A. Product Data: For the following:

1. Grout, anchoring cement, and paint products.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

C. Delegated-Design Submittal: For railings, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

1.8 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Steel Pipe and Tube Railings:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Wagner, R & B, Inc.
b. (Local Steel Fabricators).

B. Source Limitations: Obtain each type of railing from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design railings, including attachment to building construction.

B. Structural Performance: Railings, including attachment to building construction, shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Handrails and Top Rails of Guards:

a. Uniform load of 50 lbf/ ft. in accordance with Section 4.5.1 of ASCE 7.
b. Concentrated load of 200 lbf in accordance with Section 4.5.1 of ASCE 7.
c. Uniform and concentrated loads need not be assumed to act concurrently.

2. Infill of Guards:

a. Concentrated load of 50 lbf in accordance with Section 4.5.1 of ASCE 7.
b. Infill load and other loads need not be assumed to act concurrently.

2.3 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.

B. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.

1. Provide type of bracket with predrilled hole for exposed bolt anchorage and that provides 1-1/2-inch clearance from inside face of handrail to finished wall surface.

2.4 STEEL AND IRON

A. Tubing: ASTM A500 (cold formed) or ASTM A513.

B. Pipe: ASTM A53/A53M, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.

C. Plates, Shapes, and Bars: ASTM A36/A36M.

2.5 FASTENERS

A. General: Provide the following:

1. Ungalvanized-Steel Railings: Plated steel fasteners complying with ASTM B633 or ASTM F1941, Class Fe/Zn 5 for zinc coating.

B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.

C. Fasteners for Interconnecting Railing Components:

1. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless otherwise indicated.
2. Provide square or hex socket flat-head machine screws for exposed fasteners unless otherwise indicated.

D. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors capable of sustaining, without failure, a load equal to 6 times the load imposed when installed in unit masonry and 4 times the load imposed when installed in concrete, as determined by testing according to ASTM E488/E488M, conducted by a qualified independent testing agency.

1. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B633 or ASTM F1941, Class Fe/Zn 5, unless otherwise indicated.

2.6 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

B. Shop Primers: Provide product compatible with system as required that comply with Section 099123 "Interior Painting"

C. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

D. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound.

2.7 FABRICATION

A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage**,** but not less than that required to support structural loads.

B. Shop assemble railings to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.

C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

D. Form work true to line and level with accurate angles and surfaces.

E. Fabricate connections that are exposed to weather in a manner that excludes water. Provide weep holes where water may accumulate.

F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.

G. Connections: Fabricate railings with either welded or nonwelded connections unless otherwise indicated.

H. Welded Connections for Steel Railings: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove flux immediately.
4. At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.

I. Nonwelded Connections for Aluminum Railings: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.

1. Fabricate splice joints for field connection using an epoxy structural adhesive if this is manufacturer's standard splicing method.

J. Form Changes in Direction as Follows:

1. As detailed.
2. By flush bends or[by inserting prefabricated flush-elbow fittings.

K. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 1/4 inch or less.

L. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.

M. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.

N. Toe Boards: Where indicated, provide toe boards at railings around openings and at edge of open-sided floors and platforms. Fabricate to dimensions and details indicated.

2.8 STEEL AND IRON FINISHES

A. For nongalvanized-steel railings, provide nongalvanized ferrous-metal fittings, brackets, fasteners, and sleeves; however, galvanize anchors to be embedded in exterior concrete or masonry.

B. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with SSPC-SP 3, "Power Tool Cleaning." Clean surfaces to be painted per primer manufacturer's written instructions. Remove loose rust and mill scale and other spatter, slag, flux deposits, and any other potential bond-breaking materials.

C. Primer Application: Apply shop primer to prepared surfaces of railings unless otherwise indicated. Comply with requirements in SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel," for shop painting. Primer need not be applied to surfaces to be embedded in concrete or masonry.

1. Shop prime uncoated railings with primers specified in Section 099123 "Interior Painting"

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Fit exposed connections together to form tight, hairline joints.

B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.

1. Do not weld, cut, or abrade surfaces of railing components that are coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
2. Set posts plumb within a tolerance of 1/16 inch in 3 feet.
3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet.

C. Adjust railings before anchoring to ensure matching alignment at abutting joints.

D. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.2 RAILING CONNECTIONS

A. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article whether welding is performed in the shop or in the field.

B. Expansion Joints: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve extending 2 inches beyond joint on either side, fasten internal sleeve securely to one side, and locate joint within 6 inches of post.

3.3 ANCHORING POSTS

A. Form or core-drill holes not less than 5 inches deep and 3/4 inch larger than OD of post for installing posts in concrete. Clean holes of loose material, insert posts, and fill annular space between post and concrete with non-shrink, nonmetallic grout or anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions.

B. Leave anchorage joint exposed with anchoring material flush with adjacent surface.

C. Anchor posts to metal surfaces with oval flanges, angle type, or floor type as required by conditions, connected to posts and to metal supporting members as follows:

1. For steel pipe railings, weld post directly to metal supporting surfaces.

3.4 ADJUSTING AND CLEANING

A. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 099123 "Interior Painting."

3.5 PROTECTION

A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

END OF SECTION 055213

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SECTION 061000 - ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Wood products.
2. Wood-preservative-treated lumber.
3. Fire-retardant-treated lumber.
4. Miscellaneous lumber.
5. Plywood backing panels at data room.
6. Miscellaneous plywood at roof.
7. Underlayment under preservative treated wood.

B. Related Requirements:

1. Section 061600 "Sheathing" for sheathing, subflooring, and underlayment.

1.2 DEFINITIONS

A. Boards or Strips: Lumber of less than 2 inches nominal size in least dimension.

B. Dimension Lumber: Lumber of 2 inches nominal size or greater but less than 5 inches nominal size in least dimension.

C. Exposed Framing: Framing not concealed by other construction.

D. Lumber grading agencies, and abbreviations used to reference them, include the following:

1. NeLMA: Northeastern Lumber Manufacturers' Association.
2. NLGA: National Lumber Grades Authority.
3. SPIB: The Southern Pine Inspection Bureau.
4. WCLIB: West Coast Lumber Inspection Bureau.
5. WWPA: Western Wood Products Association.

1.3 ACTION SUBMITTALS

A. 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, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency in accordance with ASTM D5664.
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.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Stack wood products flat with spacers beneath and between each bundle to provide air circulation. Protect wood products from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS

A. Lumber: Comply with DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Grade lumber 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. 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 wood products.
3. Dress lumber, S4S, unless otherwise indicated.

B. Maximum Moisture Content:

1. Boards: 19 percent.

2.2 WOOD-PRESERVATIVE-TREATED LUMBER

A. Preservative Treatment by Pressure Process: AWPA U1, Use categories as follows:

1. UC2: Interior construction not in contact with ground but may be subject to moisture. Include the following items:

a. Wood sills, sleepers, blocking, furring, and similar concealed members in contact with masonry or concrete.
b. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.

c. Wood floor plates that are installed over concrete slabs-on-grade.

2. UC3B (Commodity Specification A): Uncoated sawn products in exterior construction not in contact with ground, exposed to all weather cycles including intermittent wetting but with sufficient air circulation for wood to dry. Excludes sawn products not in contact with ground but with ground contact-type hazards. Include the following items:

a. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.

3. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium. Do not use inorganic boron (SBX) for sill plates.
4. After treatment, redry boards to 19 percent maximum moisture content.

B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or that does not comply with requirements for untreated material.

C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.

D. Application: Treat items indicated on Drawings, and the following:

1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
2. Wood sills, sleepers, blocking, and similar concealed members in contact with masonry or concrete.
3. Miscellaneous plywood at roof.

2.3 FIRE-RETARDANT-TREATED LUMBER

A. General: Where fire-retardant-treated materials are indicated, materials are to comply with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested in accordance with ASTM E84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet beyond the centerline of the burners at any time during the test.

1. Treatment is not to promote corrosion of metal fasteners.
2. Interior Type A: Treated materials are to have a moisture content of 28 percent or less when tested in accordance with ASTM D3201/D3201M at 92 percent relative humidity. Use where exterior type is not indicated.
3. Design Value Adjustment Factors: Treated lumber is to be tested according to ASTM D5664 and design value adjustment factors are to be calculated according to ASTM D6841.

C. Kiln-dry lumber after treatment to maximum moisture content of 19 percent. Kiln-dry plywood after treatment to maximum moisture content of 15 percent.

D. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency and other information required by authorities having jurisdiction.

E. Application: Treat items indicated on Drawings, and the following:

1. Interior concealed blocking and nailers.
2. Plywood backing panels.

2.4 MISCELLANEOUS LUMBER

A. Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:

1. Blocking.
2. Nailers.

B. Dimension Lumber Items: Construction or No. 2 grade lumber of any of the following species:

1. Hem-fir (north); NLGA.
2. Mixed southern pine or southern pine; SPIB.
3. Spruce-pine-fir; NLGA.
4. Hem-fir; WCLIB or WWPA.
5. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.

C. Concealed Boards: 19 percent maximum moisture content and any of the following species and grades:

1. Mixed southern pine or southern pine; No. 2 grade; SPIB.
2. Hem-fir or hem-fir (north); Construction or No. 2 Common grade; NLGA, WCLIB, or WWPA.
3. Spruce-pine-fir (south) or spruce-pine-fir; Construction or No. 2 Common grade; NeLMA, NLGA, WCLIB, or WWPA.

2.5 PLYWOOD BACKING PANELS

A. Equipment Backing Panels: Plywood, DOC PS 1, Exposure 1, C-D Plugged, fire-retardant treated, in thickness indicated or, if not indicated, not less than 3/4-inch nominal thickness.

2.6 MISCELLANEOUS PLYWOOD AT ROOF

A. Miscellaneous Concealed Plywood: Exposure 1 sheathing, preservative treated, span rating to suit framing in each location, and thickness as indicated on Drawings but not less than 3/4 inch (19 mm).

2.7 FASTENERS

A. General: Fasteners are to be of size and type indicated and comply with requirements specified in this article for material and manufacture. Provide nails or screws, in sufficient length, to penetrate not less than 1-1/2 inches into wood substrate.

1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A153/A153M or ASTM F2329 or of Type 304 stainless steel.

B. Nails, Brads, and Staples: ASTM F1667.

C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

D. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01, ICC-ES AC58, ICC-ES AC193, or ICC-ES AC308 as appropriate for the substrate.

2.8 MISCELLANEOUS MATERIALS

A. Underlayment Under Preservative Treated Wood: Provide one of the following under preservative treated wood and between any metal construction:

1. Flexible Flashing: Composite, self-adhesive, flashing product consisting of a pliable, butyl rubber compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 0.025 inch.
2. Felt: Type II asphalt saturated organic felt, complying with ASTM D 226 (No. 30) or ASTM D 4869.

B. Adhesives for Gluing Furring and Sleepers to Concrete or Masonry: Formulation complying with ASTM D3498 that is approved for use indicated by adhesive manufacturer.

1. Verify adhesive complies with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Set work to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry accurately to other construction. Locate furring, nailers, blocking,and similar supports to comply with requirements for attaching other construction.

B. Install plywood backing panels by fastening to walls; coordinate locations with utilities requiring backing panels. Install fire-retardant-treated plywood backing panels with classification marking of testing agency exposed to view.

C. 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.

D. Sort and select lumber so that natural characteristics do 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.

E. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.

1. Use inorganic boron for items that are continuously protected from liquid water.
2. Use copper naphthenate for items not continuously protected from liquid water.

F. Where wood-preservative-treated lumber is installed adjacent to metal decking or any other metal construction, install continuous flexible flashing separator between wood and metal decking and metal construction.

G. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:

1. Table 2304.10.1, "Fastening Schedule," in ICC's International Building Code (IBC).
2. ICC-ES evaluation report for fastener.

H. Securely attach roofing nailers to substrates by anchoring and fastening to withstand bending, shear, or other stresses imparted by Project wind loads and fastener-resistance loads as designed in accordance with ASCE/SEI 7.

I. Use steel common 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. Drive nails snug but do not countersink nail heads unless otherwise indicated.

3.2 INSTALLATION OF WOOD BLOCKING AND NAILERS

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 wood blocking to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.

C. Attach wood roofing nailers securely to substrate to resist the designed outward and upward wind loads indicated on Drawings and in accordance with ANSI/SPRI ED-1, Tables A6 and A7.

D. Install underlayment between preservative treated wood and metal decking or other metal construction material to prevent corrosion.

END OF SECTION 061000

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SECTION 072100 - THERMAL INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Glass-fiber blanket insulation.
2. Mineral-wool blanket insulation.

B. Related Requirements:

1. Section 042000 "Unit Masonry" for insulation installed in masonry cavities.
2. Section 075423 "Thermoplastic-Polyolefin (TPO) Roofing" for insulation specified as part of roofing construction.

1.3 ACTION SUBMITTALS

A. Product Data for each type of product.

1.4 INFORMATIONAL SUBMITTALS

A. Installer's Certification: Listing type, manufacturer, and R-value of insulation installed in each element of the building thermal envelope.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

B. Protect foam-plastic board insulation as follows:

1. Do not expose to sunlight except to necessary extent for period of installation and concealment.
2. Protect against ignition at all times. Do not deliver foam-plastic board materials to Project site until just before installation time.

3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.

PART 2 - PRODUCTS

2.1 GLASS-FIBER BLANKET INSULATION

A. Verify insulation complies with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

B. Glass-Fiber Blanket Insulation, Unfaced: ASTM C665, Type I; passing ASTM E136 for combustion characteristics.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Certainteed; SAINT-GOBAIN.
    b. Johns Manville; a Berkshire Hathaway company.
    c. Knauf Insulation.
    d. Owens Corning.

2. Flame-Spread Index: Not more than 25 when tested in accordance with ASTM E84.
3. Smoke-Developed Index: Not more than 50 when tested in accordance with ASTM E84.
4. Labeling: Provide identification of mark indicating R-value of each piece of insulation 12 inches and wider in width.
5. Use for filling exterior door frames as indicated on the Drawings.

2.2 MINERAL-WOOL BLANKET INSULATION

A. Verify insulation complies with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

B. Mineral-Wool Blanket Insulation, Unfaced: ASTM C665, Type I (blankets without membrane facing); consisting of fibers; passing ASTM E136 for combustion characteristics.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Johns Manville; a Berkshire Hathaway company.
    b. Owens Corning.
    c. ROCKWOOL.

2. Flame-Spread Index: Not more than 25 when tested in accordance with ASTM E84.
3. Smoke-Developed Index: Not more than 50 when tested in accordance with ASTM E84.
4. Labeling: Provide identification of mark indicating R-value of each piece of insulation 12 inches and wider in width.
5. Use for filling interior door frames and top of wall joints as indicated on Drawings.

2.3 ACCESSORIES

A. Insulation for Miscellaneous Voids:

1. Unfaced Glass-Fiber Insulation: ASTM C 665, Type I; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.
2. Spray Polyurethane Foam Insulation: ASTM C1029, Type II, closed cell, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E84.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean substrates of substances that are harmful to insulation, including removing projections capable of puncturing insulation or vapor retarders, or that interfere with insulation attachment.

3.2 INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products and applications.

B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.

C. Install insulation with manufacturer's R-value label exposed after insulation is installed.

D. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

E. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or to achieve R-value.

3.3 PROTECTION

A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes.

B. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION 072100

SECTION 072726 - FLUID-APPLIED MEMBRANE AIR BARRIERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Vapor-permeable, fluid-applied air barriers.

1.2 DEFINITIONS

A. Air-Barrier Material: A primary element that provides a continuous barrier to the movement of air.

B. Air-Barrier Accessory: A transitional component of the air barrier that provides continuity.

C. Air-Barrier Assembly: The collection of air-barrier materials and accessories applied to an opaque wall, including joints and junctions to abutting construction, to control air movement through the wall.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review air-barrier requirements and installation, special details, mockups, air-leakage and bond testing, air-barrier protection, and work scheduling that covers air barriers.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include manufacturer's written instructions for evaluating, preparing, and treating each substrate; technical data; dry film thickness; and tested physical and performance properties of products.

B. Shop Drawings: For air-barrier assemblies.

1. Show locations and extent of air-barrier materials, accessories, and assemblies specific to Project conditions.
2. Include details for substrate joints and cracks, counterflashing strips, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.
3. Include details of interfaces with other materials that form part of air barrier.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Certificates: From air-barrier manufacturer, certifying compatibility of air barriers and accessory materials with Project materials that connect to or that come in contact with the barrier.

C. Product Test Reports: For each air-barrier assembly, for tests performed by a qualified testing agency.

D. Field quality-control reports from manufacturer's representative for final inspections of completed work.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

B. Mockups: Build mockups to set quality standards for materials and execution.

1. Build integrated mockups of exterior wall assembly 6 feet wide by 6 feet high, incorporating backup wall construction, window opening, storefront, insulation, brick ties and one pipe penetration, and flashing to demonstrate surface preparation, crack and joint treatment, application of air barriers, and sealing of gaps, terminations, and penetrations of air-barrier assembly Construct representation of parapet construction to demonstrate roofing membrane junction.

    a. Include junction with roofing membrane, base of wall flashing intersection and foundation wall intersection.
    b. If Architect determines mockups do not comply with requirements, reconstruct mockups and apply air barrier until mockups are approved.

2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Remove and replace liquid materials that cannot be applied within their stated shelf life.

B. Protect stored materials from direct sunlight.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Apply air barrier within the range of ambient and substrate temperatures recommended in writing by air-barrier manufacturer.

1. Protect substrates from environmental conditions that affect air-barrier performance.
2. Do not apply air barrier to a damp or wet substrate or during snow, rain, fog, or mist.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Source Limitations: Obtain primary air-barrier materials and air-barrier accessories from single source from single manufacturer.

B. VOC Content: 100 g/L or less.

C. Low-Emitting Materials: Verify products comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.2 PERFORMANCE REQUIREMENTS

A. Air-Barrier Performance: Air-barrier assembly and seals with adjacent construction to be capable of performing as a continuous air barrier and as a liquid-water drainage plane flashed to discharge to the exterior incidental condensation or water penetration. Air-barrier assemblies to be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, penetrations, tie-ins to installed waterproofing, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.

B. Air-Barrier Assembly Air Leakage: Maximum 0.04 cfm/sq. ft. of surface area at 1.57 lbf/sq. ft., when tested according to ASTM E2357.

2.3 HIGH-BUILD AIR BARRIERS, VAPOR PERMEABLE

A. High-Build, Vapor-Permeable Air Barrier Synthetic Polymer Type: Synthetic polymer membrane with an installed dry film thickness, according to manufacturer's written instructions, of 35 mils or thicker over smooth, void-free substrates.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Carlisle Coatings & Waterproofing Inc; Fire Resist Barrithane VP.
    b. Henry Company; Air-Bloc All Weather STPE.
    c. Hohmann & Barnard, Inc; Enviro-Barrier VP.
    d. Sto Corp.; Sto AirSeal®.
    e. TK Products Construction Coatings, a Fenix Group SPC Company; TK-Airmax 2014 Vapor Permeable.
    f. W. R. Meadows, Inc; Air-Shield LMP.

B. Physical and Performance Properties:

1. Air Permeance: Maximum 0.004 cfm/sq. ft. of surface area at 1.57-lbf/sq. ft. pressure difference; ASTM E2178.
2. Vapor Permeance: Minimum 5 perms; ASTM E96/E96M, Procedure B, Water Method.
3. Ultimate Elongation: Minimum 200 percent; ASTM D412, Die C.
4. Adhesion to Substrate: Minimum 30 lbf/sq. in. when tested according to ASTM D4541.
5. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.
6. UV Resistance: Can be exposed to sunlight for 180 days according to manufacturer's written instructions.

2.4 ACCESSORY MATERIALS

A. Provide primers, transition strips, termination strips, joint reinforcing fabric and strips, joint sealants, counterflashing strips, flashing sheets and metal termination bars, termination mastic, substrate patching materials, adhesives, tapes, foam sealants, lap sealants, and other accessory materials that are recommended in writing by air-barrier manufacturer to produce a complete air-barrier assembly and that are compatible with primary air-barrier material and adjacent construction to which they may seal.

B. Primer: Liquid waterborne primer recommended for substrate by air-barrier material manufacturer.

1. Basis of Design Product: Tremco, Inc., ExoAir Primer.

C. Stainless Steel Sheet: ASTM A240/A240M, Type 304, 0.0187 inch thick, and Series 300 stainless steel fasteners.

D. High Temperature Flashing Strip and Underlayment: Butyl, 24 mil thick self-adhering composite sheet consisting of 20 mils of butyl laminated to 4 mil polyethylene film; thermally stable under intermittent, non-continuous exposure up to 240 deg F (115 deg C) for termination of air barrier to EPDM roof membranes and to air barrier terminations at openings.

1. Basis of Design Product: Tremco, Inc., ExoAir 111.

E. Liquid Joint Sealants:

1. ASTM C 920, single-component polyurethane, approved by air barrier manufacturer for adhesion and compatibility with membrane air barrier and accessories.

a. Basis of Design Product: Tremco, Inc., Dymonic 100.

2. ASTM C 920, single-component, neutral-curing silicone, approved by air barrier manufacturer for adhesion and compatibility with membrane air barrier and accessories post installation of the membrane.

a. Basis of Design Product: Tremco, Inc., Spectrem 1.

F. Preformed Silicone Extrusion: Manufacturer's standard system consisting of cured low-modulus silicone extrusion, sized to fit opening widths, with a single-component, neutral-curing, Class 100/50 (low-modulus) silicone sealant for bonding extrusions to substrates.

1. Products: Subject to compliance with requirements, provide one of the following:

a. GE Construction Sealants; Momentive Performance Materials Inc.; US11000 UltraSpan.
b. Pecora Corporation; Sil-Span.
c. The Dow Chemical Company; Dow Corning® 123 Silicone Seal.
d. Tremco Incorporated; Spectrem Simple Seal.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

1. Verify that substrates are sound and free of oil, grease, dirt, excess mortar, or other contaminants.
2. Verify that substrates have cured and aged for minimum time recommended in writing by air-barrier manufacturer.
3. Verify that substrates are visibly dry and free of moisture.
4. Verify that masonry joints are flush and completely filled with mortar.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SURFACE PREPARATION

A. Clean, prepare, treat, fill, and seal substrate and joints and cracks in substrate according to manufacturer's written instructions and details. Provide clean, dust-free, and dry substrate for air-barrier application.

B. Mask off adjoining surfaces not covered by air barrier to prevent spillage and overspray affecting other construction.

C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.

D. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids in concrete with substrate-patching material.

E. Remove excess mortar from masonry ties, shelf angles, and other obstructions.

F. At changes in substrate plane, apply sealant or termination mastic beads at sharp corners and edges to form a smooth transition from one plane to another.

G. Cover gaps in substrate plane and form a smooth transition from one substrate plane to another with stainless steel sheet mechanically fastened to structural framing to provide continuous support for air barrier.

H. Bridge expansion joints and discontinuous wall-to-wall, deck-to-wall, and deck-to-deck joints with air-barrier accessory material that accommodates joint movement according to manufacturer's written instructions and details.

3.3 ACCESSORIES INSTALLATION

A. Install accessory materials according to air-barrier manufacturer's written instructions and details to form a seal with adjacent construction and ensure continuity of air and water barrier.

1. Coordinate the installation of air barrier with installation of roofing membrane and base flashing to ensure continuity of air barrier with roofing membrane.
2. Install transition strip on roofing membrane or base flashing so that a minimum of 3 inches of coverage is achieved over each substrate.
3. Unless manufacturer recommends in writing against priming, apply primer to substrates at required rate and allow it to dry.
4. Apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by air-barrier material on same day. Reprime areas exposed for more than 24 hours.

B. Connect and seal exterior wall air-barrier material continuously to roofing-membrane air barrier, concrete below-grade structures, floor-to-floor construction, exterior glazing and window systems, glazed curtain-wall systems, storefront systems, exterior louvers, exterior door framing, and other construction used in exterior wall openings, using accessory materials.

C. At end of each working day, seal top edge of strips and transition strips to substrate with termination mastic.

D. Apply joint sealants forming part of air-barrier assembly within manufacturer's recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.

E. Wall Openings: Prime concealed, perimeter frame surfaces of windows, curtain walls, storefronts, and doors. Apply transition strip so that a minimum of 3 inches of coverage is achieved over each substrate. Maintain 3 inches of full contact over firm bearing to perimeter frames, with not less than 1 inch of full contact.

1. Transition Strip: Roll firmly to enhance adhesion.

F. Fill gaps in perimeter frame surfaces of windows, curtain walls, storefronts, and doors, and miscellaneous penetrations of air-barrier material with foam sealant.

G. Seal strips and transition strips around masonry reinforcing or ties and penetrations with termination mastic.

H. Seal top of through-wall flashings to air barrier with an additional 6-inch- wide, transition strip.

I. Seal exposed edges of strips at seams, cuts, penetrations, and terminations not concealed by metal counterflashings or ending in reglets with termination mastic.

J. Repair punctures, voids, and deficient lapped seams in strips and transition strips. Slit and flatten fishmouths and blisters. Patch with transition strips extending 6 inches beyond repaired areas in strip direction.

3.4 PRIMARY AIR-BARRIER MATERIAL INSTALLATION

A. Apply air-barrier material to form a seal with strips and transition strips and to achieve a continuous air barrier according to air-barrier manufacturer's written instructions and details. Apply air-barrier material within manufacturer's recommended application temperature ranges.

1. Unless manufacturer recommends in writing against priming, apply primer to substrates at required rate and allow it to dry.
2. Limit priming to areas that will be covered by air-barrier material on same day. Reprime areas exposed for more than 24 hours.
3. Where multiple prime coats are needed to achieve required bond, allow adequate drying time between coats.

B. High-Build Air Barriers: Apply continuous unbroken air-barrier material to substrates according to the following thickness. Apply air-barrier material in full contact around protrusions such as masonry ties.

1. Vapor-Retarding, High-Build Air Barrier: Total dry film thickness as recommended in writing by manufacturer to comply with performance requirements, not less than 40 mils, applied in two equal coats.

C. Do not cover air barrier until it has been inspected.

D. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply air-barrier components.

3.5 FIELD QUALITY CONTROL

A. Engage a manufacturer’s representative to inspect air barrier installation.

B. Inspections: Air-barrier materials, accessories, and installation are subject to inspection for compliance with requirements. Inspections include the following:

1. Continuity of air-barrier system has been achieved throughout the building envelope with no gaps or holes.
2. Air-barrier dry film thickness.
3. Continuous structural support of air-barrier system has been provided.
4. Masonry and concrete surfaces are smooth, clean, and free of cavities, protrusions, and mortar droppings.
5. Site conditions for application temperature and dryness of substrates have been maintained.

6. Maximum exposure time of materials to UV deterioration has not been exceeded.
7. Surfaces have been primed, if applicable.
8. Laps in strips and transition strips have complied with minimum requirements and have been shingled in the correct direction (or mastic has been applied on exposed edges), with no fishmouths.
9. Termination mastic has been applied on cut edges.
10. Strips and transition strips have been firmly adhered to substrate.
11. Compatible materials have been used.
12. Transitions at changes in direction and structural support at gaps have been provided.
13. Connections between assemblies (air-barrier and sealants) have complied with requirements for cleanliness, surface preparation and priming, structural support, integrity, and continuity of seal.
14. All penetrations have been sealed.

C. Air barriers will be considered defective if they do not pass tests inspections.

1. Apply additional air-barrier material, according to manufacturer's written instructions, where inspection results indicate insufficient thickness.
2. Remove and replace deficient air-barrier components for reinspection as specified above.

D. Repair damage to air barriers caused by testing; follow manufacturer's written instructions.

E. Prepare test and inspection reports.

3.6 CLEANING AND PROTECTION

A. Protect air-barrier system from damage during application and remainder of construction period, according to manufacturer's written instructions.

1. Protect air barrier from exposure to UV light and harmful weather exposure as recommended in writing by manufacturer. If exposed to these conditions for longer than recommended, remove and replace air barrier or install additional, full-thickness, air-barrier application after repairing and preparing the overexposed materials according to air-barrier manufacturer's written instructions.
2. Protect air barrier from contact with incompatible materials and sealants not approved by air-barrier manufacturer.

B. Clean spills, stains, and soiling from construction that would be exposed in the completed work using cleaning agents and procedures recommended in writing by manufacturer of affected construction.

C. Remove masking materials after installation.

END OF SECTION 072726

SECTION 075423 - THERMOPLASTIC-POLYOLEFIN (TPO) ROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Thermoplastic polyolefin (TPO) roofing system.
2. Accessory roofing materials.
3. Roof insulation.
4. Insulation accessories and cover board.
5. Walkways.

B. Section includes installation of sound-absorbing insulation strips in ribs of roof deck. Sound-absorbing insulation strips are furnished under Section 053100 "Steel Decking."

C. Related Requirements:

1. Section 061000 "Rough Carpentry" for wood nailers, curbs, and blocking; and for wood-based, structural-use roof deck panels.
2. Section 076200 "Sheet Metal Flashing and Trim" for metal roof flashings and counterflashings.
3. Section 079200 "Joint Sealants" for joint sealants, joint fillers, and joint preparation.
4. Section 221119 "Plumbing Specialties" for roof drains.

1.2 DEFINITIONS

A. Roofing Terminology: Definitions in ASTM D1079 and glossary in NRCA's "The NRCA Roofing Manual: Membrane Roof Systems" apply to Work of this Section.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Roofing Conference: Conduct conference at Project site.

1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer, air barrier Installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
3. Review and finalize construction schedule, and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
4. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.

5. Review structural loading limitations of roof deck during and after roofing.
6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that affects roofing system.
7. Review governing regulations and requirements for insurance and certificates if applicable.
8. Review temporary protection requirements for roofing system during and after installation.
9. Review roof observation and repair procedures after roofing installation.

1.4 ACTION SUBMITTALS

A. Product Data for each type of product:

1. For insulation and roof system component fasteners, include copy of SPRI's Directory of Roof Assemblies listing.

B. Shop Drawings: Include roof plans, sections, details, and attachments to other work, including the following:

1. Layout and thickness of insulation.
2. Base flashings and membrane termination details.
3. Flashing details at penetrations.
4. Tapered insulation layout, thickness, and slopes.
5. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.
6. Tie-in with adjoining air barrier.

C. Wind Uplift Resistance Submittal: For roofing system, indicating compliance with wind uplift performance requirements.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and manufacturer.

B. Manufacturer Certificates:

1. Performance Requirement Certificate: Signed by roof membrane manufacturer, certifying that roofing system complies with requirements specified in "Performance Requirements" Article.

a. Submit evidence of compliance with performance requirements.

2. Special Warranty Certificate: Signed by roof membrane manufacturer, certifying that all materials supplied under this Section are acceptable for special warranty.

C. Product Test Reports: For roof membrane and insulation, for tests performed by a qualified testing agency, indicating compliance with specified requirements.

D. Evaluation Reports: For components of roofing system, from ICC-ES.

E. Field quality-control reports.

F. Sample Warranties: For manufacturer's special warranties.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For roofing system to include in maintenance manuals.

B. Certified statement from existing roof membrane manufacturer stating that existing roof warranty has not been affected by Work performed under this Section.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer that is listed in SPRI's Directory of Roof Assemblies for roofing system identical to that used for this Project.

B. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing and mixing with other components.

B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.

1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.

C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.

D. Handle and store roofing materials, and place equipment in a manner to avoid permanent deflection of deck.

1.9 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

1.10 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of roofing system that fail in materials or workmanship within specified warranty period.

1. Special warranty includes roof membrane, base flashings, roof insulation, fasteners, cover boards, roof accessories, and other components of roofing system.
2. Peak Wind Gust: Up to 72 mph.
3. Hail Coverage: 1 inch diameter.
4. Warranty Period: 20 years from date of Substantial Completion.

B. Special Project Warranty: Submit roofing Installer's warranty, on warranty form at end of this Section, signed by Installer, covering the Work of this Section, including all components of roofing system such as roof membrane, base flashing, roof insulation, fasteners, cover boards, and walkway products, for the following warranty period:

1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General Performance: Installed roofing system and flashings to withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Roof system and flashings to remain watertight.

1. Accelerated Weathering: Roof to withstand 2000 hours of exposure when tested according to ASTM G152, ASTM G154, or ASTM G155.
2. Impact Resistance: Roof membrane to resist impact damage when tested according to ASTM D3746, ASTM D4272, or the "Resistance to Foot Traffic Test" in FM Approvals 4470.

B. Material Compatibility: Roofing materials to be compatible with one another and adjacent materials under conditions of service and application required, as demonstrated by roof membrane manufacturer based on testing and field experience.

C. Wind Uplift Resistance: Design roofing system to resist the following wind uplift pressures according to ASCE-7-22 for geographical location exposure C, local area MPH 3-second gust wind speed zone and risk category III based on the International Building Code requirements. Minimum allowable stress design values (ASD) are as follows based on the gymnasium roof area and shall be verified by the Contractor:

1. Zone 1': (Roof Area Center): 34.8 lbf/sq.ft..
2. Zone 1 (Roof Area Field): 54.0 lbf/sq. ft..
3. Zone 2 (Roof Area Perimeter): 68.4 lbf/sq. ft..

a. Location: From roof edge to 0.6 of wall height inside roof edge.

4. Zone 3 (Roof Area Corners): 90.1 lbf/sq. ft..

    a. Location: 0.6 of wall height in each direction from each building corner.

D. SPRI's Directory of Roof Assemblies Listing: Roof membrane, base flashings, and component materials comply with requirements in FM Approvals 4450 or FM Approvals 4470 as part of a roofing system, and are listed in SPRI's Directory of Roof Assemblies for roof assembly identical for that specified for this Project.

1. Wind Uplift Load Capacity: 75 psf.

E. Solar Reflectance Index: Not less than 78 when calculated according to ASTM E 1980, based on testing identical products by a qualified testing agency.

F. Retain "Energy Star Listing" Paragraph below for roofs that must comply with Energy Star requirements. The DOE's Energy Star "Roof Products Qualified Product List" is available in PDF at www.energystar.gov.

G. Energy Star Listing: Roofing system to be listed on the DOE's Energy Star "Roof Products Qualified Product List" for low -slope roof products.

H. Exterior Fire-Test Exposure: ASTM E108 or UL 790, Class A; for application and roof slopes indicated; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

I. Fire-Resistance Ratings: Comply with fire-resistance-rated assembly designs indicated. Identify products with appropriate markings of applicable testing agency.

2.2 THERMOPLASTIC POLYOLEFIN (TPO) ROOFING SYSTEM

A. TPO Sheet: ASTM D6878/D6878M, internally fabric- or scrim-reinforced, TPO sheet.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Carlisle SynTec Incorporated.
    b. Elevate.
    c. GAF Materials Corporation.
    d. Versico Incorporated.

2. Source Limitations: Obtain components for roofing system from roof membrane manufacturer or manufacturers approved by roof membrane manufacturer.
3. Thickness: 60 mils, nominal.
4. Exposed Face Color: White.

2.3 ACCESSORY ROOFING MATERIALS

A. General: Accessory materials recommended by roofing system manufacturer for intended use and compatible with other roofing components.

1. Adhesive and Sealants: Comply with VOC limits of authorities having jurisdiction.

B. Sheet Flashing: Manufacturer's standard unreinforced TPO sheet flashing, 55 mils thick, minimum, of same color as TPO sheet.

C. Prefabricated Pipe Flashings: As recommended by roof membrane manufacturer.

D. Bonding Adhesive: Manufacturer's standard, water based.

E. Metal Termination Bars: Manufacturer's standard, predrilled stainless steel or aluminum bars, approximately 1 by 1/8 inch thick; with anchors.

F. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roofing components to substrate, and acceptable to roofing system manufacturer.

G. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, lap sealants, termination reglets, and other accessories.

2.4 ROOF INSULATION

A. General: Preformed roof insulation boards manufactured or approved by TPO roof membrane manufacturer , approved for use in SPRI's Directory of Roof Assemblies listed roof assemblies.

B. Molded (Expanded) Polystyrene Board Insulation (EPS): ASTM C578, Type VIII, 1.25-lb/cu. ft. minimum density, 15-psi minimum compressive strength, square edge.

1. Contractors Option: Use of molded-polystyrene board insulation, in lieu of polyisocyanurate board insulation is acceptable, for tapered insulation only, if the tapered molded-polystyrene insulation is sandwiched between flat, polyisocyanurate insulation boards.
2. Available Products: Subject to compliance with requirements, provide, but not limited to, products by the following:

    a. Insulfoam; Carlisle Construction Materials Company; InsulFoam Type VII Tapered.

3. Thermal Resistance: R-value of 3.92 per 1 inch.
4. Size: 48 by 48 inches or 48 by 96 inches.

C. Polyisocyanurate Board Insulation: ASTM C1289, Type II, Class 1, Grade 2, felt or glass-fiber mat facer on both major surfaces.

1. Compressive Strength: 20 psi.
2. Size: 48 by 96 inches.
3. Thickness:

    a. Two layers of 2.2 inches (55.9 mm). Total LTTR value of 25.2.

D. Tapered Insulation: Provide factory-tapered insulation boards.

1. Minimum Thickness: 1/4 inch.
2. Slope:

    a. Roof Field: Fabricated to provide minimum 1/4 inch per foot unless otherwise indicated on Drawings.
    b. Saddles and Crickets: Fabricated to provide twice the slope of roof field or minimum 1/2 inch per foot unless otherwise indicated on Drawings.

2.5 INSULATION ACCESSORIES AND COVER BOARD

A. General: Roof insulation accessories recommended by insulation manufacturer for intended use and compatibility with other roofing system components.

B. Fasteners: Factory-coated steel fasteners with metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roof insulation and cover boards to substrate, and acceptable to roofing system manufacturer.

C. Insulation Adhesive: Insulation manufacturer's recommended adhesive formulated to attach roof insulation to substrate or to another insulation layer as follows:

1. Bead-applied, low-rise, one-component or multicomponent urethane adhesive.
2. Full-spread, spray-applied, low-rise, two-component urethane adhesive.

D. Cover Boards: Provide one of the following:

1. Glass-Mat Gypsum Cover Board: ASTM C1177/C1177M, water-resistant gypsum board.

    a. Products: Subject to compliance with requirements, provide one of the following:

        1) Georgia-Pacific Building Products: Dens Deck Prime.
        2) United States Gypsum Company: SECUREROCK® Ultralight Coated Glass-Mat Roof Board.

    b. Thickness: 1/2 inch.
    c. Surface Finish: Factory primed.

2. Fiber-Reinforced Gypsum Roof Board: ASTM C1278/C1278M, cellulosic-fiber reinforced, water-resistant gypsum board.

    a. Products: Subject to compliance with requirements, provide one of the following:

1) United States Gypsum Company: SECUREROCK® Gypsum-fiber Roof Board.

b. Thickness: 1/2 inch.

2.6 WALKWAYS

A. Flexible Walkways: Factory-formed, nonporous, heavy-duty, slip-resisting, surface-textured walkway pads, approximately 3/16 inch thick and acceptable to roofing system manufacturer.

1. Size: Approximately36 by 60 inches.
2. Color: Contrasting with roof membrane.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

1. Verify that roof openings and penetrations are in place, curbs are set and braced, and roof-drain bodies are securely clamped in place.
2. Verify that wood blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.
3. Verify that surface plane flatness and fastening of steel roof deck complies with requirements in Section 053100 "Steel Decking."

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing system installation according to roofing system manufacturer's written instructions. Remove sharp projections.

B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.

C. Perform fastener-pullout tests according to roof system manufacturer's written instructions.

1. Submit test result within 24 hours after performing tests.

a. Include manufacturer's requirements for any revision to previously submitted fastener patterns required to achieve specified wind uplift requirements.

D. Install sound-absorbing insulation strips according to acoustical roof deck manufacturer's written instructions.

3.3 INSTALLATION OF ROOFING, GENERAL

A. Install roofing system according to roofing system manufacturer's written instructions, SPRI's Directory of Roof Assemblies listed roof assembly requirements, and FM Global Property Loss Prevention Data Sheet 1-29.

B. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at end of workday or when rain is forecast. Remove and discard temporary seals before beginning Work on adjoining roofing.

C. Install roof membrane and auxiliary materials to tie in to existing roofing to maintain weathertightness of transition and to not void warranty for existing roofing system.

D. Coordinate installation and transition of roofing system component serving as an air barrier with air barrier specified under Section 072726 "Fluid-Applied Membrane Air Barriers."

3.4 INSTALLATION OF INSULATION

A. Coordinate installing roofing system components so insulation is not exposed to precipitation or left exposed at end of workday.

B. Comply with roofing system and roof insulation manufacturer's written instructions for installing roof insulation.

C. Installation Over Metal Decking:

1. Install base layer of insulation with end joints staggered not less than 12 inches in adjacent rows and with long joints continuous at right angle to flutes of decking.

    a. Locate end joints over crests of decking.
    b. Where installing composite and noncomposite insulation in two or more layers, install noncomposite board insulation for bottom layer and intermediate layers, if applicable, and install composite board insulation for top layer.
    c. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
    d. Make joints between adjacent insulation boards not more than 1/4 inch in width.
    e. At internal roof drains, slope insulation to create a square drain sump with each side equal to the diameter of the drain bowl plus 24 inches.

        1) Trim insulation so that water flow is unrestricted.

    f. Fill gaps exceeding 1/4 inch with insulation.
    g. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.

h. Mechanically attach base layer of insulation using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to metal decks.

1) Fasten insulation according to requirements in SPRI's Directory of Roof Assemblies for specified Wind Uplift Load Capacity.
2) Fasten insulation to resist specified uplift pressure at corners, perimeter, and field of roof.

2. Install upper layers of insulation and tapered insulation with joints of each layer offset not less than 12 inches from previous layer of insulation.

a. Staggered end joints within each layer not less than 24 inches in adjacent rows.
b. Install with long joints continuous and with end joints staggered not less than 12 inches in adjacent rows.
c. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
d. Make joints between adjacent insulation boards not more than 1/4 inch in width.
e. At internal roof drains, slope insulation to create a square drain sump with each side equal to the diameter of the drain bowl plus 24 inches.

1) Trim insulation so that water flow is unrestricted.

f. Fill gaps exceeding 1/4 inch with insulation.
g. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.
h. Adhere upperlayers of insulation to substrate using adhesive according to SPRI's Directory of Roof Assemblies listed roof assembly requirements for specified Wind Uplift Load Capacity and FM Global Property Loss Prevention Data Sheet 1-29, as follows:

1) Set each layer of insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
2) Or set each layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

3.5 INSTALLATION OF COVER BOARDS

A. Install cover boards over insulation with long joints in continuous straight lines with end joints staggered between rows. Offset joints of insulation below a minimum of 6 inches in each direction.

1. Trim cover board neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
2. At internal roof drains, conform to slope of drain sump.

a. Trim cover board so that water flow is unrestricted.

3. Cut and fit cover board tight to nailers, projections, and penetrations.

4. Adhere cover board to substrate using adhesive according to SPRI's Directory of Roof Assemblies listed roof assembly requirements for specified Wind Uplift Load Capacity and FM Global Property Loss Prevention Data Sheet 1-29, as follows:

    a. Set cover board in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
    b. Or set cover board in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

3.6 INSTALLATION OF ADHERED ROOF MEMBRANE

A. Adhere roof membrane over area to receive roofing according to roofing system manufacturer's written instructions.

B. Unroll roof membrane and allow to relax before installing.

C. Start installation of roofing in presence of roofing system manufacturer's technical personnel.

D. Accurately align roof membrane, and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.

E. Bonding Adhesive: Apply to substrate and underside of roof membrane at rate required by manufacturer, and allow to partially dry before installing roof membrane. Do not apply to splice area of roof membrane.

F. In addition to adhering, mechanically fasten roof membrane securely at terminations, penetrations, and perimeter of roofing.

G. Apply roof membrane with side laps shingled with slope of roof deck where possible.

H. Seams: Clean seam areas, overlap roof membrane, and hot-air weld side and end laps of roof membrane and sheet flashings, to ensure a watertight seam installation.

1. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of roof membrane and sheet flashings.
2. Verify field strength of seams a minimum of twice daily, and repair seam sample areas.
3. Repair tears, voids, and lapped seams in roof membrane that do not comply with requirements.

I. Spread sealant bed over deck-drain flange at roof drains, and securely seal roof membrane in place with clamping ring.

3.7 INSTALLATION OF BASE FLASHING

A. Install sheet flashings and preformed flashing accessories, and adhere to substrates according to roofing system manufacturer's written instructions.

B. Apply bonding adhesive to substrate and underside of sheet flashing at required rate, and allow to partially dry. Do not apply to seam area of flashing.

C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.

D. Clean seam areas, overlap, and firmly roll sheet flashings into the adhesive. Hot-air weld side and end laps to ensure a watertight seam installation.

E. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.

3.8 INSTALLATION OF WALKWAYS

A. Flexible Walkways:

1. Install flexible walkways at the following locations:

    a. Locations indicated on Drawings.
    b. As required by roof membrane manufacturer's warranty requirements.

2. Provide 6-inch clearance between adjoining pads.
3. Heat weld to substrate or adhere walkway products to substrate with compatible adhesive according to roofing system manufacturer's written instructions.

3.9 FIELD QUALITY CONTROL

A. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion, in presence of Architect, and to prepare inspection report.

B. Repair or remove and replace components of roofing system where inspections indicate that they do not comply with specified requirements.

C. Additional testing and inspecting, at Contractor's expense, will be performed to determine if replaced or additional work complies with specified requirements.

3.10 PROTECTING AND CLEANING

A. Protect roofing system from damage and wear during remainder of construction period. When remaining construction does not affect or endanger roofing system, inspect roofing system for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.

B. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

3.11 ROOFING INSTALLER'S WARRANTY

A. WHEREAS _____ of _____, herein called the "Roofing Installer," has performed roofing and associated work ("work") on the following project:

1. Owner: <**Insert name of Owner**>.
2. Owner Address: <**Insert address**>.
3. Building Name/Type: <**Insert information**>.
4. Building Address: <**Insert address**>.
5. Area of Work: <**Insert information**>.
6. Acceptance Date: _____.
7. Warranty Period: <**Insert time**>.
8. Expiration Date: _____.

B. AND WHEREAS Roofing Installer has contracted (either directly with Owner or indirectly as a subcontractor) to warrant said work against leaks and faulty or defective materials and workmanship for designated Warranty Period,

C. NOW THEREFORE Roofing Installer hereby warrants, subject to terms and conditions herein set forth, that during Warranty Period Roofing Installer will, at Roofing Installer's own cost and expense, make or cause to be made such repairs to or replacements of said work as are necessary to correct faulty and defective work and as are necessary to maintain said work in a watertight condition.

D. This Warranty is made subject to the following terms and conditions:

1. Specifically excluded from this Warranty are damages to work and other parts of the building, and to building contents, caused by:

    a. lightning;
    b. peak gust wind speed exceeding 72 mph;
    c. fire;
    d. failure of roofing system substrate, including cracking, settlement, excessive deflection, deterioration, and decomposition;
    e. faulty construction of parapet walls, copings, chimneys, skylights, vents, equipment supports, and other edge conditions and penetrations of the work;
    f. vapor condensation on bottom of roofing; and
    g. activity on roofing by others, including construction contractors, maintenance personnel, other persons, and animals, whether authorized or unauthorized by Owner.

2. When work has been damaged by any of foregoing causes, Warranty shall be null and void until such damage has been repaired by Roofing Installer and until cost and expense thereof have been paid by Owner or by another responsible party so designated.

3. Roofing Installer is responsible for damage to work covered by this Warranty but is not liable for consequential damages to building or building contents resulting from leaks or faults or defects of work.
4. During Warranty Period, if Owner allows alteration of work by anyone other than Roofing Installer, including cutting, patching, and maintenance in connection with penetrations, attachment of other work, and positioning of anything on roof, this Warranty shall become null and void on date of said alterations, but only to the extent said alterations affect work covered by this Warranty. If Owner engages Roofing Installer to perform said alterations, Warranty shall not become null and void unless Roofing Installer, before starting said work, shall have notified Owner in writing, showing reasonable cause for claim, that said alterations would likely damage or deteriorate work, thereby reasonably justifying a limitation or termination of this Warranty.
5. During Warranty Period, if original use of roof is changed and it becomes used for, but was not originally specified for, a promenade, work deck, spray-cooled surface, flooded basin, or other use or service more severe than originally specified, this Warranty shall become null and void on date of said change, but only to the extent said change affects work covered by this Warranty.
6. Owner shall promptly notify Roofing Installer of observed, known, or suspected leaks, defects, or deterioration and shall afford reasonable opportunity for Roofing Installer to inspect work and to examine evidence of such leaks, defects, or deterioration.
7. This Warranty is recognized to be the only warranty of Roofing Installer on said work and shall not operate to restrict or cut off Owner from other remedies and resources lawfully available to Owner in cases of roofing failure. Specifically, this Warranty shall not operate to relieve Roofing Installer of responsibility for performance of original work according to requirements of the Contract Documents, regardless of whether Contract was a contract directly with Owner or a subcontract with Owner's General Contractor.

E. IN WITNESS THEREOF, this instrument has been duly executed this _____ day of _____, _____.

1. Authorized Signature: _____.
2. Name: _____.
3. Title: _____.

END OF SECTION 075423

SECTION 076200 - SHEET METAL FLASHING AND TRIM

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. Formed low-slope roof sheet metal fabrications.
2. Formed equipment support flashing.

B. Related Requirements:

1. Section 061053 "Miscellaneous Rough Carpentry" for wood nailers, curbs, and blocking.
2. Section 075423 "Thermoplastic-Polyolefin (TPO) Roofing” for installation of sheet metal flashing and trim integral with roofing.

1.3 COORDINATION

A. Coordinate sheet metal flashing and trim layout and seams with sizes and locations of penetrations to be flashed, and joints and seams in adjacent materials.

B. Coordinate sheet metal flashing and trim installation with adjoining roofing and wall materials, joints, and seams to provide leakproof, secure, and noncorrosive installation.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site

1. Review construction schedule. Verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
2. Review special roof details, roof drainage, roof-penetration flashing, equipment curbs, and condition of other construction that affect sheet metal flashing and trim.
3. Review requirements for insurance and certificates if applicable.
4. Review sheet metal flashing observation and repair procedures after flashing installation.

1.5 ACTION SUBMITTALS

A. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each manufactured product and accessory.

B. Shop Drawings: For sheet metal flashing and trim.

1. Include plans, elevations, sections, and attachment details.
2. Detail fabrication and installation layouts, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled Work.
3. Include identification of material, thickness, weight, and finish for each item and location in Project.
4. Include details for forming, including profiles, shapes, seams, and dimensions.
5. Include details for joining, supporting, and securing, including layout and spacing of fasteners, cleats, clips, and other attachments. Include pattern of seams.
6. Include details of termination points and assemblies.
7. Include details of expansion joints and expansion-joint covers, including showing direction of expansion and contraction from fixed points.
8. Include details of roof-penetration flashing.
9. Include details of edge conditions, including eaves, ridges, valleys, rakes, crickets, flashings, and counterflashings.
10. Include details of special conditions.
11. Detail formed flashing and trim at scale of not less than 3 inches per 12 inches.

C. Samples for Initial Selection: For each type of sheet metal and accessory indicated with factory-applied finishes.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For fabricator.

B. Product Certificates: For each type of coping and roof edge flashing that isANSI/SPRI/FM 4435/ES-1 tested.

C. Sample Warranty: For special warranty.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For sheet metal flashing and trim, and its accessories, to include in maintenance manuals.

B. Special warranty.

1.8 QUALITY ASSURANCE

A. Fabricator Qualifications: Employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.

1. For copings and roof edge flashings that are ANSI/SPRI/FM 4435/ES-1 tested , shop shall be listed as able to fabricate required details as tested and approved.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage.

1. Store sheet metal flashing and trim materials away from uncured concrete and masonry.
2. Protect stored sheet metal flashing and trim from contact with water.

B. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to extent necessary for period of sheet metal flashing and trim installation.

1.10 WARRANTY

A. Special Warranty on Finishes: Manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows 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 Delta units when tested in accordance with ASTM D2244.
b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General: Sheet metal flashing and trim assemblies, including cleats, anchors, and fasteners, shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.

B. Sheet Metal Standard for Flashing and Trim: Comply with NRCA's "The NRCA Roofing Manual: Architectural Metal Flashing, Condensation and Air Leakage Control, and Reroofing" and[SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.

C. SPRI Wind Design Standard: Manufacture and install copingsand roof edge flashings tested in accordance with ANSI/SPRI/FM 4435/ES-1 and capable of resisting the following design pressure:

1. Design Pressure: As determined by the basic wind speed at the Project site as shown on the Structural Drawings and as determined by ASCE-7-22.

D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 SHEET METALS

A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.

B. Metallic-Coated Steel Sheet: Provide zinc-coated (galvanized) steel sheet in accordance with ASTM A653/A653M, G90 coating designation; prepainted by coil-coating process to comply with ASTM A755/A755M.

1. Surface: Smooth, flat.
2. Exposed Coil-Coated Finish:

a. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (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.

3. Color:

a. Prefinished Metal Coping-1: As selected by Architect from manufacturer’s full range and as indicated on Drawings to match existing coping color.

4. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with minimum total dry film thickness of 0.5 mil.

2.3 UNDERLAYMENT MATERIALS

A. Felt: ASTM D226/D226M, Type II (No. 30), asphalt-saturated organic felt; nonperforated.

2.4 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and as recommended by manufacturer of primary sheet metal unless otherwise indicated.

B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal.

1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.

    a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating. Provide metal-backed EPDM or PVC sealing washers under heads of exposed fasteners bearing on weather side of metal.
    b. Blind Fasteners: High-strength aluminum or stainless steel rivets suitable for metal being fastened.

2. Fasteners for Zinc-Coated (Galvanized) Steel Sheet: Series 300 stainless steel or hot-dip galvanized steel in accordance with ASTM A153/A153M or ASTM F2329.

C. Sealant Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.

D. Elastomeric Sealant: ASTM C920, elastomeric polyurethane polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

E. Butyl Sealant: ASTM C1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.

F. Bituminous Coating: Cold-applied asphalt emulsion in accordance with ASTM D1187/D1187M.

G. Asphalt Roofing Cement: ASTM D4586, asbestos free, of consistency required for application.

2.5 FABRICATION, GENERAL

A. Custom fabricate sheet metal flashing and trim to comply with details indicated and recommendations in cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of item required.

1. Fabricate sheet metal flashing and trim in shop to greatest extent possible.
2. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
3. Verify shapes and dimensions of surfaces to be covered and obtain field measurements for accurate fit before shop fabrication.

4. Form sheet metal flashing and trim to fit substrates without excessive oil-canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
5. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.

B. Fabrication Tolerances:

1. Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of 1/4 inch in 20 feet on slope and location lines indicated on Drawings and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.
2. Fabricate sheet metal flashing and trim that is capable of installation to tolerances specified.

C. Expansion Provisions: Form metal for thermal expansion of exposed flashing and trim.

1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with butyl sealant concealed within joints.
2. Use lapped expansion joints only where indicated on Drawings.

D. Sealant Joints: Where movable, nonexpansion-type joints are required, form metal in accordance with cited sheet metal standard to provide for proper installation of elastomeric sealant.

E. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.

F. Fabricate cleats and attachment devices of sizes as recommended by cited sheet metal standard and by FM Global Property Loss Prevention Data Sheet 1-49 for application, but not less than thickness of metal being secured.

G. Seams:

1. Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use. Rivet joints where necessary for strength.

H. Do not use graphite pencils to mark metal surfaces.

2.6 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

A. Copings: Fabricate in minimum 96-inch- long, but not exceeding 12-foot- long, sections. Fabricate joint plates of same thickness as copings. Furnish with continuous cleats to support edge of external leg and drill elongated holes for fasteners on interior leg. Miter corners, fasten and seal watertight. Shop fabricate interior and exterior corners.

1. Coping Profile: Fig. 3-4Ain accordance with SMACNA's "Architectural Sheet Metal Manual."

2. Joint Style: Butted with expansion space and 6-inch- wide, concealed backup plate .
3. Fabricate from the following materials:

a. Galvanized Steel: 0.028 inch (0.71 mm) (24 gauge) thick thick.

B. Counterflashing: Shop fabricate interior and exterior corners. Fabricate from the following materials:

1. Galvanized Steel: 0.028 inch (0.71 mm) (24 gauge) thick.

C. Flashing Receivers: Fabricate from the following materials:

1. Galvanized Steel: 0.028 inch (0.71 mm) (24 gauge) thick.

2.7 MISCELLANEOUS SHEET METAL FABRICATIONS

A. Equipment Support Flashing: Fabricate from the following materials:

1. Galvanized Steel: 0.028 inch (24 gauge) thick.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with installer present, for compliance with requirements for installation tolerances, substrate, and other conditions affecting performance of the Work.

1. Verify compliance with requirements for installation tolerances of substrates.
2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
3. Verify that air- or water-resistant barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF UNDERLAYMENT

A. Felt Underlayment: Install felt underlayment, wrinkle free, using adhesive to minimize use of mechanical fasteners under sheet metal flashing and trim.

1. Install in shingle fashion to shed water.
2. Lap joints not less than 2 inches.

3.3 INSTALLATION, GENERAL

A. Install sheet metal flashing and trim to comply with details indicated and recommendations of cited sheet metal standard that apply to installation characteristics required unless otherwise indicated on Drawings.

1. Install fasteners protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
2. Install sheet metal flashing and trim true to line, levels, and slopes. Provide uniform, neat seams with minimum exposure of solder, welds, sealant.
3. Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement.
4. Install sheet metal flashing and trim to fit substrates and to result in watertight performance.
5. Install continuous cleats with fasteners spaced not more than 12 inches o.c.
6. Space individual cleats not more than 12 inches apart. Attach each cleat with at least two fasteners. Bend tabs over fasteners.
7. Install exposed sheet metal flashing and trim with limited oil-canning, and free of buckling and tool marks.
8. Do not field cut sheet metal flashing and trim by torch.
9. Do not use graphite pencils to mark metal surfaces.

B. Metal Protection: Where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates, protect against galvanic action or corrosion by painting contact surfaces with bituminous coating or by other permanent separation as recommended by sheet metal manufacturer or cited sheet metal standard.

1. Underlayment: Where installing sheet metal flashing and trim directly on cementitious or wood substrates, install underlayment and cover with slip sheet.

C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim.

1. Space movement joints at maximum of 12 feet with no joints within 24 inches of corner or intersection.
2. Form expansion joints of 1/2 inch gap minimum between sheet metal with exposed cover plate or concealed backup plate as indicated and edges , filled with sealant concealed within joints.

D. Fasteners: Use fastener sizes that penetrate wood blocking or sheathing not less than 1-1/4 inches for nails and not less than 3/4 inch for wood screws For masonry substrates, use fastner sizes not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.

E. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.

F. Seal joints as required for watertight construction.

1. Use sealant-filled joints unless otherwise indicated.

    a. Embed hooked flanges of joint members not less than 1 inch into sealant.
    b. Form joints to completely conceal sealant.
    c. When ambient temperature at time of installation is between 40 and 70 deg F, set joint members for 50 percent movement each way.
    d. Adjust setting proportionately for installation at higher ambient temperatures.

        1) Do not install sealant-type joints at temperatures below 40 deg F.

2. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."

G. Rivets: Rivet joints in where necessary for strength.

3.4 INSTALLATION OF ROOF FLASHINGS

A. Install sheet metal flashing and trim to comply with performance requirements and cited sheet metal standard.

1. Provide concealed fasteners where possible, and set units true to line, levels, and slopes.
2. Install work with laps, joints, and seams that are permanently watertight and weather resistant.

B. Roof Edge Flashing:

1. Anchor to resist uplift and outward forces in accordance with recommendations in FM Global Property Loss Prevention Data Sheet 1-49 for FM Approvals' listing for required windstorm classification.

C. Copings:

1. Install roof edge flashings in accordance with ANSI/SPRI/FM 4435/ES-1.

D. Counterflashing: Coordinate installation of counterflashing with installation of base flashing.

1. Insert counterflashing in reglets or receivers and fit tightly to base flashing.
2. Extend counterflashing 4 inches over base flashing.
3. Lap counterflashing joints minimum of 4 inches.
4. Secure in waterproof manner by means of anchor and washer spaced at 12 inches o.c. along perimeter and 6 inches o.c. at corners areas unless otherwise indicated.

E. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Seal with elastomeric sealant and clamp flashing to pipes that penetrate roof.

3.5 INSTALLATION OF MISCELLANEOUS FLASHING

A. Equipment Support Flashing:

1. Coordinate installation of equipment support flashing with installation of roofing and equipment.
2. Weld or seal flashing with elastomeric sealant to equipment support member.

3.6 INSTALLATION TOLERANCES

A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 feet on slope and location lines indicated on Drawings and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.7 CLEANING

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Clean and neutralize flux materials. Clean off excess solder.

C. Clean off excess sealants.

3.8 PROTECTION

A. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions.

B. On completion of sheet metal flashing and trim installation, remove unused materials and clean finished surfaces as recommended in writing by sheet metal flashing and trim manufacturer.

C. Maintain sheet metal flashing and trim in clean condition during construction.

D. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures, as determined by Architect.

END OF SECTION 076200

SECTION 078100 - APPLIED FIRE PROTECTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Sprayed fire-resistive materials.

1.2 DEFINITIONS

A. SFRM: Sprayed fire-resistive materials.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review products, design ratings, restrained and unrestrained conditions, densities, thicknesses, bond strengths, and other performance requirements.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Framing plans or schedules, or both, indicating the following:

1. Extent of applied fire protection for each construction and fire-resistance rating.
2. Applicable fire-resistance design designations of a qualified testing and inspecting agency acceptable to authorities having jurisdiction.
3. Minimum applied fire protection material thicknesses needed to achieve required fire-resistance rating of each structural component and assembly.
4. Treatment of sprayed fire-resistive material after application.

C. Samples: For each exposed product and for each color and texture specified, 4 inches square in size.

1.5 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each type of applied fire protection material for tests performed by a qualified testing agency.

B. Research Reports: For each type of applied fire protection material, from ICC-ES.

C. Preconstruction Test Reports: For each type of applied fire protection material.

D. Field Quality-Control Reports: For each type of applied fire protection material.

E. Qualification Statements: For Installer } testing agency.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A firm or individual certified, licensed, or otherwise qualified by applied fire protection material manufacturer as experienced and with sufficient trained staff to install manufacturer's products in accordance with specified requirements.

1.7 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Owner will engage a qualified testing agency to perform preconstruction testing on field mockups of applied fire protection.

1. Field Mockup: Insert sizes and configurations of assembliesOne column and one floor beam test area large enough to perform the tests.
2. Provide test specimens and assemblies representative of proposed materials and construction.

B. Preconstruction Adhesion and Compatibility Testing: Test for compliance with requirements for specified performance and test methods.

1. Bond Strength: Test for cohesive and adhesive strength in accordance with ASTM E736/E736M. Provide bond strength indicated in referenced fire-resistance design, but not less than minimum specified in Part 2.
2. Density: Test for density in accordance with ASTM E605/E605M. Provide density indicated in referenced fire-resistance design, but not less than minimum specified in Part 2.
3. Verify that manufacturer, through its own laboratory testing or field experience, attests that primers or coatings are compatible with applied fire protection material.
4. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
5. For materials failing tests, obtain applied fire protection material manufacturer's written instructions for corrective measures including the use of specially formulated bonding agents or primers.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Do not apply applied fire protection when ambient or substrate temperature is 44 deg F or lower unless temporary protection and heat are provided to maintain temperature at or above this level for 24 hours before, during, and for 24 hours after product application.

B. Ventilation: Ventilate building spaces during and after application of fire protection, providing complete air exchanges in accordance with manufacturer's written instructions. Use natural means or, if they are inadequate, forced-air circulation until fire protection dries thoroughly.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain applied fire protection from single source.

2.2 PERFORMANCE REQUIREMENTS

A. Assemblies: Provide applied fire protection, including auxiliary materials, in accordance with requirements of each fire-resistance design and manufacturer's written instructions.

B. Fire-Resistance Design: Indicated on Drawings, tested in accordance with ASTM E119 or UL 263; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Steel members are to be considered unrestrained unless specifically noted otherwise.

C. Asbestos: Provide products containing no detectable asbestos.

2.3 SPRAYED FIRE-RESISTIVE MATERIALS

A. Sprayed Fire-Resistive Material: Manufacturer's standard, factory-mixed, lightweight, dry formulation, complying with indicated fire-resistance design, and mixed with water at Project site to form a slurry or mortar before conveyance and application or conveyed in a dry state and mixed with atomized water at place of application.

1. Carboline; Pyrocrete®.
2. GCP Applied Technologies Inc; Monokote® MK-6.
3. Isolatek International; Cafco® Blaze-Shield® II / Isolatek® Type II.
4. Application: Designated for exterior use by a qualified testing agency acceptable to authorities having jurisdiction.
5. Bond Strength: Minimum 150-lbf/sq. ft. cohesive and adhesive strength based on field testing in accordance with ASTM E736/E736M.
6. Density: Not less than density specified in the approved fire-resistance design, in accordance with ASTM E605/E605M.
7. Thickness: As required for fire-resistance design indicated, measured in accordance with requirements of fire-resistance design or ASTM E605/E605M, whichever is thicker, but not less than 0.375 inch.
8. Combustion Characteristics: ASTM E136.
9. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
    a. Flame-Spread Index: 10 or less.
    b. Smoke-Developed Index: 10 or less.
10. Compressive Strength: Minimum 10 lbf/sq. in. in accordance with ASTM E761/E761M.

11. Corrosion Resistance: No evidence of corrosion in accordance with ASTM E937/E937M.
12. Deflection: No cracking, spalling, or delamination in accordance with ASTM E759/E759.
13. Effect of Impact on Bonding: No cracking, spalling, or delamination in accordance with ASTM E760/E760M.
14. Air Erosion: Maximum weight loss of 0.025 g/sq. ft. in 24 hours in accordance with ASTM E859/E859M.
15. Fungal Resistance: Treat products with manufacturer's standard antimicrobial formulation to result in no growth on specimens per ASTM G21.

2.4 AUXILIARY MATERIALS

A. Provide auxiliary materials that are compatible with sprayed fire-resistive material and substrates and are approved by UL or another testing and inspecting agency acceptable to authorities having jurisdiction for use in fire-resistance designs indicated.

B. Substrate Primers: Primers approved in writing by sprayed fire-resistive material manufacturer and complying with one or both of the following requirements:

1. Primer and substrate are identical to those tested in required fire-resistance design by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
2. Primer's bond strength in required fire-resistance design complies with specified bond strength for sprayed fire-resistive material and with requirements in UL's "Product iQ" online directory or in the listings of another qualified testing agency acceptable to authorities having jurisdiction, based on a series of bond tests in accordance with ASTM E736/E736M.

C. Bonding Agent: Product approved in writing by sprayed fire-resistive material manufacturer and complying with requirements in UL's "Product iQ" online directory or in the listings of another qualified testing agency acceptable to authorities having jurisdiction.

D. Metal Lath: Expanded metal lath fabricated from material of weight, configuration, and finish required, in accordance with fire-resistance designs indicated and sprayed fire-resistive material manufacturer's written instructions. Include clips, lathing accessories, corner beads, and other anchorage devices required to attach lath to substrates and to receive sprayed fire-resistive material.

E. Reinforcing Fabric: Glass- or carbon-fiber fabric of type, weight, and form required to comply with fire-resistance designs indicated; approved and provided by sprayed fire-resistive material manufacturer.

F. Reinforcing Mesh: Metallic mesh reinforcement of type, weight, and form required to comply with fire-resistance design indicated; approved and provided by sprayed fire-resistive material manufacturer. Include pins and attachment.

G. Sealer: Transparent-drying, water-dispersible, tinted protective coating recommended in writing by sprayed fire-resistive material manufacturer for each fire-resistance design.

H. Topcoat: Suitable for application over sprayed fire-resistive material; of type recommended in writing by sprayed fire-resistive material manufacturer for each fire-resistance design.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for substrates and other conditions affecting performance of the Work and in accordance with each fire-resistance design.

1. Verify that substrates are free of dirt, oil, grease, release agents, rolling compounds, mill scale, loose scale, incompatible primers, paints, and encapsulants, or other foreign substances capable of impairing bond of applied fire protection with substrates under conditions of normal use or fire exposure.
2. Verify that objects penetrating applied fire protection, including clips, hangers, support sleeves, and similar items, are securely attached to substrates.
3. Verify that substrates receiving applied fire protection are not obstructed by ducts, piping, equipment, or other suspended construction that will interfere with fire protection application.

B. Verify that concrete work on steel deck is complete before beginning Work.

C. Verify that roof construction, installation of rooftop HVAC equipment, and other related work are complete before beginning Work.

D. Conduct tests in accordance with sprayed fire-resistive material manufacturer's written instructions to verify that substrates are free of substances capable of interfering with bond.

E. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

F. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Cover other work subject to damage from fallout or overspray of applied fire protection materials during application.

B. Clean substrates of substances that could impair bond of applied fire protection.

C. Prime substrates where included in fire-resistance design and where recommended in writing by sprayed fire-resistive material manufacturer unless compatible shop primer has been applied and is in satisfactory condition to receive applied fire protection.

D. For applications visible on completion of Project, repair substrates to remove surface imperfections that could affect uniformity of texture and thickness in finished surface of applied fire protection. Remove minor projections and fill voids that would telegraph through applied fire protection after application.

3.3 APPLICATION

A. Construct applied fire protection assemblies that are identical to fire-resistance design indicated and products as specified, tested, and substantiated by test reports; for thickness, primers, sealers, topcoats, finishing, and other materials and procedures affecting applied fire protection Work.

B. Comply with sprayed fire-resistive material manufacturer's written instructions for mixing materials, application procedures, and types of equipment used to mix, convey, and apply fire protection; as applicable to particular conditions of installation and as required to achieve fire-resistance ratings indicated.

C. Coordinate application of fire protection with other construction to minimize need to cut or remove applied fire protection.

1. Do not begin applying fire protection until clips, hangers, supports, sleeves, and other items penetrating fire protection are in place.
2. Defer installing ducts, piping, and other items that would interfere with applying fire protection until application of fire protection is completed.

D. Metal Decks:

1. Do not apply fire protection to underside of metal deck substrates until concrete topping, if any, is completed.
2. Do not apply fire protection to underside of metal roof deck until roofing is completed; prohibit roof traffic during application and drying of fire protection.

E. Install auxiliary materials as required, as detailed, and in accordance with fire-resistance design and sprayed fire-resistive material manufacturer's written instructions for conditions of exposure and intended use. For auxiliary materials, use attachment and anchorage devices of type recommended in writing by sprayed fire-resistive material manufacturer.

F. Spray apply fire protection to maximum extent possible. After the spraying operation in each area, complete the coverage by trowel application or other placement method recommended in writing by sprayed fire-resistive material manufacturer.

G. Extend applied fire protection in full thickness over entire area of each substrate to be protected.

H. Install body of applied fire protection in a single course unless otherwise recommended in writing by sprayed fire-resistive material manufacturer.

I. Where sealers are used, apply products that are tinted to differentiate them from applied fire protection over which they are applied.

J. Provide a uniform finish complying with description indicated for each type of applied fire protection material and matching finish approved for required mockups.

K. Cure applied fire protection in accordance with sprayed fire-resistive material manufacturer's written instructions.

L. Do not install enclosing or concealing construction until after applied fire protection has been inspected, tested, and corrections have been made to deficient applications.

M. Finishes: Where indicated, apply fire protection to produce the following finishes:

1. Manufacturer's Standard Finishes: Finish in accordance with manufacturer's written instructions for each finish selected.
2. Spray-Textured Finish: Finish left as spray applied with no further treatment.

3.4 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:

1. Test and inspect as required by the IBC, Subsection 1705.15, "Sprayed Fire-Resistant Materials."

B. Perform the tests and inspections of completed Work in successive stages. Do not proceed with application of fire protection for the next area until test results for previously completed applications of fire protection show compliance with requirements. Tested values must equal or exceed values as specified and as indicated and required for approved fire-resistance design.

C. Applied fire protection will be considered defective if it does not pass tests and inspections.

1. Remove and replace applied fire protection that does not pass tests and inspections, and retest.
2. Apply additional applied fire protection, in accordance with manufacturer's written instructions, where test results indicate insufficient thickness, and retest.

D. Prepare test and inspection reports.

3.5 CLEANING

A. Immediately after completing spraying operations in each containable area of Project, remove material overspray and fallout from surfaces of other construction and clean exposed surfaces to remove evidence of soiling.

3.6 PROTECTION

A. Protect applied fire protection from damage resulting from construction operations or other causes in accordance with manufacturer's and Installer's written instructions, so applied fire protection is without damage or deterioration at time of Substantial Completion.

3.7 REPAIRS

A. As installation of other adjacent construction proceeds, inspect applied fire protection and repair damaged areas due to work of other trades before concealing it with other construction.

B. Repair applied fire protection using same method and materials as original installation or using manufacturer's recommended trowel-applied repair product.

END OF SECTION 078100

SECTION 078413 - PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Penetrations in fire-resistance-rated walls.
2. Penetrations in horizontal assemblies.

B. Related Requirements:

1. Section 078443 "Joint Firestopping" for joints in or between fire-resistance-rated construction, at exterior curtain-wall/floor intersections, and in smoke barriers.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Product Schedule: For each penetration firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing and inspecting agency.

1. Engineering Judgments: Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping system, submit illustration, with modifications marked, approved by penetration firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly. Obtain approval of authorities having jurisdiction prior to submittal.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For each penetration firestopping system, for tests performed by a qualified testing agency.

1.6 CLOSEOUT SUBMITTALS

A. Installer Certificates: From Installer indicating that penetration firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not install penetration firestopping system when ambient or substrate temperatures are outside limits permitted by penetration firestopping system manufacturers or when substrates are wet because of rain, frost, condensation, or other causes.

B. Install and cure penetration firestopping materials per manufacturer's written instructions using natural means of ventilations or, where this is inadequate, forced-air circulation.

1.8 COORDINATION

A. Coordinate construction of openings and penetrating items to ensure that penetration firestopping systems can be installed according to specified firestopping system design.

B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping systems.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics:

1. Perform penetration firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
2. Test per testing standards referenced in "Penetration Firestopping Systems" Article. Provide rated systems complying with the following requirements:

a. Penetration firestopping systems shall bear classification marking of a qualified testing agency.

1) UL in its "Fire Resistance Directory."
2) Intertek Group in its "Directory of Listed Building Products."

2.2 PENETRATION FIRESTOPPING SYSTEMS

A. Penetration Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems and joint firestopping systems shall be compatible with one another, with the substrates forming openings, with penetrating items if any, and from a single source firestop manufacturer.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Hilti, Inc.; CFS-DID or comparable product by one of the following:

    a. 3M Fire Protection Products.
    b. Specified Technologies, Inc.

B. Penetrations in Fire-Resistance-Rated Walls: Penetration firestopping systems with ratings determined per ASTM E814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.

1. F-Rating: Not less than the fire-resistance rating of constructions penetrated.

C. Penetrations in Horizontal Assemblies: Penetration firestopping systems with ratings determined per ASTM E814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.

1. F-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated.
2. T-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated except for floor penetrations within the cavity of a wall.
3. W-Rating: Provide penetration firestopping systems showing no evidence of water leakage when tested according to UL 1479.

D. Exposed Penetration Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, per ASTM E84.

1. Verify sealant has a VOC content of 250 g/L or less.
2. Sealant Primers for Nonporous Substrates: 250 g/L.
3. Sealant Primers for Porous Substrates: 775 g/L.

E. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping system manufacturer and approved by qualified testing and inspecting agency for conditions indicated.

1. Permanent forming/damming/backing materials.
2. Substrate primers.
3. Collars.
4. Steel sleeves.

2.3 FILL MATERIALS

A. Through Penetration Firestop Systems:

1. Hilti Basis-of-Design Products:

a. FS-ONE MAX Intumescent Firestop Sealant
b. CP 604 Self-leveling Firestop Sealant
c. CP 620 Fire Foam
d. CP 606 Flexible Firestop Sealant
e. CP 601S Elastomeric Firestop Sealant

B. Firestop Devices:

1. Factory-assembled collars lined with intumescent material sized to fit specific outside diameter of penetrating item.
2. Hilti Basis-of-Design Products:

a. CP 680-P Cast-in-Place Firestop Device
b. CP 680-M Cast-in-Place Firestop Device
c. CP 681 Tub Box Kit
d. CFS-DID Firestop Device

C. Intumescent Pads, Wall Opening Protective Materials:

1. Intumescent, non-curing pads or inserts for protection of electrical panels, switch and receptacle boxes, medical gas outlets and valve boxes and other items recessed in face of fire rated walls.
2. Hilti Basis-of-Design Products:

a. CFS-P PA Firestop Putty Pad
b. CP 617 Firestop Putty Pad
c. Hilti Box Insert

D. Fire-rated Cable Pathways:

1. Usage:

a. Cables passing through fire-rated floors or walls shall pass through fire-rated cable pathway devices made from an intumescent material that adjusts automatically to cable additions or subtractions.

2. Product Description and Requirements:

a. Pathway device modules comprised of steel raceway and intumescent pads with adjustable smoke seal sleeve.
b. F-Rating equal to the rating of barrier the device penetrates.
c. Pathway devices shall be capable of allowing a 0 to 100 percent fill of cables.
d. Size to accommodate quantity and size of electrical wires and data cables indicated plus 100 percent expansion.

e. Provide wire devices with steel wall plates allowing for single or multiple devices ganged together without requiring additional wall structure framing.

3. Hilti Basis-of-Design Products:

a. CP 653 Speed Sleeve

1) Use in Conjunction with CFS-SL GP (Gang Plate) when more than 1 device is required

b. CFS-CC Firestop Cable Collar

E. Firestop Putty:

1. Intumescent, non-hardening, water resistant putties containing no solvents, inorganic fibers or silicone compounds.
2. Firestop Putty shall be provided and installed at, but not limited to, the gap between wire, cabling, or both, exiting an open end of conduit, where conduit penetrates one or both sides of a smoke or fire rated wall assembly.
3. Hilti Basis-of-Design Products:

a. CP 618 Firestop Putty Stick
b. CFS-PL Firestop Plug

F. Wrap Strips:

1. Single component intumescent elastomeric strips faced on both sides with a plastic film:
2. Hilti Basis-of-Design Products:

a. CP 643N Firestop Collar
b. CP 644 Firestop Collar
c. CP 648E/648S Wrap Strips

G. Firestop Blocks:

1. Re-enterable, non-curing, ready to use, intumescent flexible block designed to seal medium to large size openings.
2. Hilti Basis-of-Design Products:

a. CFS-BL Fire Block
b. CFS-PL Firestop Plug

H. Mortar:

1. Portland cement based dry-mix product formulated for mixing with water at Project site to form a non-shrinking, water-resistant, homogenous mortar.
2. Hilti Basis-of-Design Product:

a. CP 637 Firestop Mortar

I. Silicone Sealants:

1. Moisture curing, single component, silicone elastomeric sealant for horizontal surfaces pourable or nonsag or vertical surface nonsag
2. Hilti Basis-of-Design Products:

a. CP 601S Elastomeric Firestop Sealant
b. CP 604 Self Leveling Silicone Firestop Sealant
c. CFS-S SIL SL Self Leveling Silicon Firestop Sealant

J. Pre-formed mineral wool:

1. Hilti Basis-of-Design Products:

a. CP 767 Speed Strips
b. CP 777 Speed Plugs

K. Fire Sealant:

1. Single component latex or acrylic formulations that upon cure do not re-emulsify during exposure to moisture

a. Hilti Basis-of-Design Products:

1) CP 601S Elastic Firestop Sealant
2) CP 606 Fire Resistant Joint Filler
3) CP 672 Firestop Joint Spray
4) CFS-SP WB Firestop Joint Spray

L. Composite Sheet:

1. Non-curing, re-penetrable material
2. Hilti Basis-of-Design Products:

a. CP 675T Firestop Board
b. CFS-BL FireBlock

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of the Work.

B. Job Site Review: Prior to submission of shop drawings, review each penetration to be firestopped for selection of Classified penetration firestopping systems.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning: Before installing penetration firestopping systems, clean out openings immediately to comply with manufacturer's written instructions and with the following requirements:

1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of penetration firestopping materials.
2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with penetration firestopping materials. Remove loose particles remaining from cleaning operation.
3. Remove laitance and form-release agents from concrete.

B. Prime substrates where recommended in writing by manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

3.3 INSTALLATION

A. General: Install penetration firestopping systems to comply with manufacturer's written installation instructions and published drawings for products and applications.

B. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings.

1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not forming permanent components of firestopping.

C. Install fill materials by proven techniques to produce the following results:

1. Fill voids and cavities formed by openings, forming materials, accessories and penetrating items to achieve required fire-resistance ratings.
2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

D. Sleeves Containing Cabling Without Cable Pathway Device: After installation of cabling, install removable pillow type or removable intumescent non-hardening putty type firestopping in all sleeves containing or designated to contain cabling in the future. Standard putties or sealants shall not be accepted.

3.4 IDENTIFICATION

A. Wall Identification: Permanently label walls containing penetration firestopping systems with the words "FIRE AND/OR SMOKE BARRIER - PROTECT ALL OPENINGS," using lettering not less than 3 inches high and with minimum 0.375-inch strokes.

1. Locate in accessible concealed floor, floor-ceiling, or attic space at 15 feet from end of wall and at intervals not exceeding 30 feet.
2. Provide labels for all fire and smoke walls.
3. Do not lable on walls that are exposed to view from the public spaces.
4. Do not label on walls sides that exposed to view from public spaces.

3.5 FIELD QUALITY CONTROL

A. Owner will engage a qualified testing agency to perform tests and inspections according to ASTM E2174.

B. Where deficiencies are found or penetration firestopping system is damaged or removed because of testing, repair or replace penetration firestopping system to comply with requirements.

C. Proceed with enclosing penetration firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.

3.6 CLEANING AND PROTECTION

A. Clean off excess fill materials adjacent to openings as the Work progresses by methods and with cleaning materials that are approved in writing by penetration firestopping system manufacturers and that do not damage materials in which openings occur.

B. Provide final protection and maintain conditions during and after installation that ensure that penetration firestopping systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, immediately cut out and remove damaged or deteriorated penetration firestopping material and install new materials to produce systems complying with specified requirements.

3.7 PENETRATION FIRESTOPPING SYSTEM SCHEDULE

A. Where UL-classified systems are indicated, they refer to system numbers in UL's "Fire Resistance Directory" under product Category XHEZ.

B. Penetration Firestopping Systems with No Penetrating Items:

1. UL-Classified Systems: C-BJ-, F-B-, and W-J- 0001-0999.

C. Penetration Firestopping Systems for Metallic Pipes, Conduit, or Tubing:

1. UL-Classified Systems: C-BJ-, C-BK-, F-B-, W-J-, and W-K- 1001-1999.

D. Penetration Firestopping Systems for Nonmetallic Pipe, Conduit, or Tubing:

1. UL-Classified Systems: C-BJ-, C-BK-, F-B-, W-J, and W-K- 2001-2999.

E. Penetration Firestopping Systems for Electrical Cables:

1. UL-Classified Systems: C-BJ-,C-BK-, F-B-, W-J-, and W-K-, 3001-3999.

F. Penetration Firestopping Systems for Cable Trays with Electric Cables:

1. UL-Classified Systems: C-BJ-, F-B-, W-J-, and W-K- 4001-4999.

G. Penetration Firestopping Systems for Insulated Pipes:

1. UL-Classified Systems: C-BJ-, C-BK-, F-B-,W-J-5001-5999.

H. Penetration Firestopping Systems for Miscellaneous Electrical Penetrants:

1. UL-Classified Systems: C-BJ-, and W-L-, W-J- 6001-6999.

I. Penetration Firestopping Systems for Miscellaneous Mechanical Penetrants:

1. UL-Classified Systems: C-BJ-, F-B-,W-J- 7001-7999.

J. Penetration Firestopping Systems for Groupings of Penetrants:

1. UL-Classified Systems: C-BJ-, F-B-, W-J- 8001-8999.

END OF SECTION 078413

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SECTION 078443 - JOINT FIRESTOPPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Joints in or between fire-resistance-rated constructions.

B. Related Requirements:

1. Section 078413 "Penetration Firestopping" for penetrations in fire-resistance-rated walls, horizontal assemblies, and smoke barriers and for wall identification.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Product Schedule: For each joint firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing agency.

1. Engineering Judgments: Where Project conditions require modification to a qualified testing agency's illustration for a particular joint firestopping system condition, submit illustration, with modifications marked, approved by joint firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For each joint firestopping system, for tests performed by a qualified testing agency.

1.6 CLOSEOUT SUBMITTALS

A. Installer Certificates: From Installer indicating that joint firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not install joint firestopping systems when ambient or substrate temperatures are outside limits permitted by joint firestopping system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.

B. Install and cure joint firestopping systems per manufacturer's written instructions using natural means of ventilation or, where this is inadequate, forced-air circulation.

1.8 COORDINATION

A. Coordinate construction of joints to ensure that joint firestopping systems can be installed according to specified firestopping system design.

B. Coordinate sizing of joints to accommodate joint firestopping systems.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics:

1. Perform joint firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
2. Test per testing standards referenced in "Joint Firestopping Systems" Article. Provide rated systems complying with the following requirements:

a. Joint firestopping systems shall bear classification marking of a qualified testing agency.

1) UL in its "Fire Resistance Directory."
2) Intertek Group in its "Directory of Listed Building Products."

2.2 JOINT FIRESTOPPING SYSTEMS

A. Joint Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of assemblies in or between which joint firestopping systems are installed. Joint firestopping systems shall accommodate building movements without impairing their ability to resist the passage of fire and hot gases.

B. Joints in or between Fire-Resistance-Rated Construction: Provide joint firestopping systems with ratings determined per ASTM E1966 or UL 2079.

1. Basis-of-Design Manufacturer: Subject to compliance with requirements, provide Hilti, Inc. or comparable products by one of the following:

a. 3M Fire Protection Products.
b. Specified Technologies, Inc.

2. Fire-Resistance Rating: Equal to or exceeding the fire-resistance rating of the wall, floor, or roof in or between which it is installed.

C. Flexible Sprayable Head-of-Wall Coating:

1. Basis-of-Design Products: Subject to compliance with requirements provide the following Hilti, Inc. products in accordance with a UL-Classified system as indicated in Joint Firestopping System Schedule at the end of Part 3:

a. CFS-SP WB Firestop Joint Spray.
b. CP 601S Elastomeric Firestop Sealant.
c. CP 606 Flexible Firestop Sealant.
d. CP 604 Self-leveling Firestop Sealant.

D. Joints at CMU/Floor Intersections: Provide joint firestopping systems with smoke rating determined per ASTM E2307.

1. Basis-of-Design Manufacturer: Subject to compliance with requirements, provide Hilti, Inc. or comparable product by one of the following:

a. 3M Fire Protection Products.
b. Specified Technologies, Inc.

E. Exposed Joint Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E84.

1. Architectural Sealants content of 250 g/L or less.
2. Sealant Primers for Nonporous Substrates: 250 g/L.
3. Sealant Primers for Porous Substrates: 775 g/L.

F. Accessories: Provide components of joint firestopping systems, including primers and forming materials, that are needed to install elastomeric fill materials and to maintain ratings required. Use only components specified by joint firestopping system manufacturer and approved by the qualified testing agency for conditions indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for joint configurations, substrates, and other conditions affecting performance of the Work.

B. Job Site Review: Prior to submission of shop drawings, review each joint for selection of Classified joint firestopping systems.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning: Before installing joint firestopping systems, clean joints immediately to comply with fire-resistive joint system manufacturer's written instructions and the following requirements:

1. Remove from surfaces of joint substrates foreign materials that could interfere with adhesion of elastomeric fill materials or compromise fire-resistive rating.
2. Clean joint substrates to produce clean, sound surfaces capable of developing optimum bond with elastomeric fill materials. Remove loose particles remaining from cleaning operation.
3. Remove laitance and form-release agents from concrete.

B. Prime substrates where recommended in writing by joint firestopping system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

3.3 INSTALLATION

A. General: Install joint firestopping systems to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.

B. Install forming materials and other accessories of types required to support elastomeric fill materials during their application and in position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.

1. After installing elastomeric fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of fire-resistive joint system.

C. Install elastomeric fill materials for joint firestopping systems by proven techniques to produce the following results:

1. Elastomeric fill voids and cavities formed by joints and forming materials as required to achieve fire-resistance ratings indicated.

2. Apply elastomeric fill materials so they contact and adhere to substrates formed by joints.
3. For elastomeric fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 FIELD QUALITY CONTROL

A. Inspecting Agency: Owner will engage a qualified testing agency to perform tests and inspections according to ASTM E2393.

B. Where deficiencies are found or joint firestopping systems are damaged or removed due to testing, repair or replace joint firestopping systems so they comply with requirements.

C. Proceed with enclosing joint firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.

3.5 CLEANING AND PROTECTION

A. Clean off excess elastomeric fill materials adjacent to joints as the Work progresses by methods and with cleaning materials that are approved in writing by joint firestopping system manufacturers and that do not damage materials in which joints occur.

B. Provide final protection and maintain conditions during and after installation that ensure joint firestopping systems are without damage or deterioration at time of Substantial Completion. If damage or deterioration occurs despite such protection, cut out and remove damaged or deteriorated joint firestopping systems immediately and install new materials to produce joint firestopping systems complying with specified requirements.

3.6 JOINT FIRESTOPPING SYSTEM SCHEDULE

A. Where UL-classified systems are indicated, they refer to system numbers in UL's "Fire Resistance Directory" under product Category XHBN.

B. Wall-to-Wall, Joint Firestopping Systems at CMU Control Joints:

1. Available UL-Classified Systems: WW-D- 0032.

C. Perimeter Joint Firestopping Systems (Perimeter Floor to CMU Wall): Smoke rated sealant per Section 079219 “Acoustical Joint Sealants.”

END OF SECTION 078443

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SECTION 079219 - ACOUSTICAL JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes acoustical joint sealants.

B. Related Requirements:

1. Section 079200 "Joint Sealants" for elastomeric, latex, and butyl-rubber-based joint sealants for nonacoustical applications.

1.3 ACTION SUBMITTALS

A. Product Data: For each acoustical joint sealant.

B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

C. Acoustical-Joint-Sealant Schedule: Include the following information:

1. Joint-sealant application, joint location, and designation.
2. Joint-sealant manufacturer and product name.
3. Joint-sealant formulation.
4. Joint-sealant color.

1.4 INFORMATIONAL SUBMITTALS

A. Sample Warranties: For special warranties.

1.5 WARRANTY

A. Special Installer's Warranty: Installer agrees to repair or replace acoustical joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

B. Special Manufacturer's Warranty: Manufacturer agrees to furnish acoustical joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Provide acoustical joint-sealant products that effectively reduce airborne sound transmission through perimeter joints and openings in building construction, as demonstrated by testing representative assemblies according to ASTM E90.

1. Verify sealant has a VOC content of 250 g/L or less.

2.2 ACOUSTICAL JOINT SEALANTS

A. Acoustical Sealant for Exposed and Concealed Joints: Manufacturer's standard nonsag, paintable, nonstaining latex acoustical sealant complying with ASTM C834.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Accumetric LLC; BOSS 826 Acoustical Sound Sealant.
b. Franklin International; Titebond GREENchoice Acoustical Smoke & Sound Sealant.
c. GE Construction Sealants; Momentive Performance Materials Inc.; RCS20 Acoustical.
d. Grabber Construction Products; Acoustical Sealant GSC.
e. Hilti, Inc.; CP 506 Smoke and Acoustical Sealant.
f. OSI Sealants; Henkel Corporation; OSI Pro-Series SC-175 Acoustical Sound Sealant.
g. Pecora Corporation; AC-20 FTR and AIS-919.
h. Serious Energy Inc.; Quiet Seal Pro.
i. Tremco Incorporated; Tremco Acoustical Sealant.
j. United States Gypsum Company; SHEETROCK Acoustical Sealant.

2. Colors of Exposed Acoustical Joint Sealants: As selected by Architect from manufacturer's full range of colors.

2.3 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by acoustical-joint-sealant manufacturer where required for adhesion of sealant to joint substrates.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints indicated to receive acoustical joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing acoustical joint sealants to comply with joint-sealant manufacturer's written instructions.

B. Joint Priming: Prime joint substrates where recommended by acoustical-joint-sealant manufacturer. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF ACOUSTICAL JOINT SEALANTS

A. Comply with acoustical joint-sealant manufacturer's written installation instructions unless more stringent requirements apply.

B. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical joint sealant. Install acoustical joint sealants at both faces of partitions, at perimeters, and through penetrations. Comply with ASTM C919, ASTM C1193, and manufacturer's written recommendations for closing off sound-flanking paths around or through assemblies, including sealing partitions to underside of floor slabs above acoustical ceilings.

C. Acoustical Ceiling Areas: Apply acoustical joint sealant at perimeter edge moldings of acoustical ceiling areas in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.

3.4 CLEANING

A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of acoustical joint sealants and of products in which joints occur.

3.5 PROTECTION

A. Protect acoustical joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out, remove, and repair damaged or deteriorated acoustical joint sealants immediately so installations with repaired areas are indistinguishable from original work.

END OF SECTION 079219

SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes:

1. Interior standard steel doors and frames.
2. Exterior standard steel doors and frames.

B. Related Requirements:

1. Section 087100 "Door Hardware" for door hardware for hollow-metal doors.

1.3 DEFINITIONS

A. Minimum Thickness: Minimum thickness of base metal without coatings according to NAAMM-HMMA 803 or ANSI/SDI A250.8.

1.4 COORDINATION

A. Coordinate anchorage installation for hollow-metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

B. Coordinate requirements for installation of door hardware, electrified door hardware, and access control and security systems.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, core descriptions, fire-resistance ratings, and finishes.

B. Shop Drawings: Include the following:

1. Elevations of each door type.
2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
4. Locations of reinforcement and preparations for hardware.
5. Details of each different wall opening condition.
6. Details of electrical raceway and preparation for electrified hardware, access control systems, and security systems.
7. Details of anchorages, joints, field splices, and connections.
8. Details of accessories.
9. Details of moldings, removable stops, and glazing.
10. Coordination of glazing frames and stops with glass and glazing requirements.

C. Product Schedule: For hollow-metal doors and frames, prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final door hardware schedule.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver hollow-metal doors and frames palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.

1. Provide additional protection to prevent damage to factory-finished units.

B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

C. Store hollow-metal doors and frames vertically under cover at Project site with head up. Place on minimum 4-inch- high wood blocking. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain hollow-metal work built to these specifications from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings and temperature-rise limits indicated on Drawings, based on testing at positive pressure according to NFPA 252 or UL 10C.

1. Smoke- and Draft-Control Door Assemblies: Listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing according to UL 1784 and installed in compliance with NFPA 105.
2. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification by a qualified testing agency that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.

B. Thermally Rated Door Assemblies: Provide door assemblies with U-factor of not more than current International Energy Conservation Code when tested according to ASTM C518.

2.3 INTERIOR STANDARD STEEL DOORS AND FRAMES

A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

B. Extra-Heavy-Duty Doors and Frames: ANSI/SDI A250.8, Level 3; ANSI/SDI A250.4, Level A. At locations indicated in the Door and Frame Schedule.

1. Doors:

   a. Type: As indicated in the Door and Frame Schedule.
   b. Thickness: 1-3/4 inches.
   c. Face: Uncoated steel sheet, minimum thickness of 0.053 inch.
   d. Edge Construction: Model 2, Seamless**,** continuously welded seam dressed smooth, no exceptions.
   e. Core: One of the following at manufacturer’s discretion:.

      1) Polystyrene.
      2) Polyurethane.
      3) Vertical steel stiffeners with mineral wool or fiberglass insulation.

   f. Fire-Rated Core: Manufacturer's standard vertical steel stiffener, laminated mineral board core for fire-rated doors.

2. Frames:

   a. Materials: Uncoated, steel sheet, minimum thickness of 0.053 inch.
   b. Construction: Full profile welded.

3. Exposed Finish: Prime, compatible with topcoats specified in Section 099123 “Interior Painting.”

2.4 EXTERIOR STANDARD STEEL DOORS AND FRAMES

A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

B. Extra-Heavy-Duty Doors and Frames: ANSI/SDI A250.8, Level 3; ANSI/SDI A250.4, Level A. At locations indicated in the Door and Frame Schedule. Physical Performance: Level A according to SDI A250.4.

1. Doors:

a. Type: As indicated in the Door and Frame Schedule.
b. Thickness: 1-3/4 inches.
c. Face: Metallic-coated steel sheet, minimum thickness of 0.053 inch, with minimum A40 coating.
d. Edge Construction: Model 2, Seamless continuously welded seam dressed smooth, no exceptions .
e. Top Edge Closures: Close top edges of doors with flush closures of same material as face sheets. Seal joints against water penetration.
f. Bottom Edges: Close bottom edges of doors with end closures or channels of same material as face sheets. Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape.
g. Core: Manufacturer's standard polystyrene, polyurethane, or vertical steel-stiffener core at manufacturer's discretion. If steel stiffeners are used, door shall be filled with mineral fiber or fiberglass insulation.

1) Thermal-Rated Doors: Provide doors fabricated with thermal-resistance value (R-value) of not less than 2.1 deg F x h x sq. ft./Btu when tested according to ASTM C 1363.

h. Fire-Rated Core: Manufacturer's standard vertical steel stiffener with insulation or laminated mineral board core for fire-rated doors.

2. Frames:

a. Materials: Metallic-coated steel sheet, minimum thickness of 0.067 inch, with minimum **A40** coating.
b. Construction: Full profile welded.

3. Exposed Finish: Prime, compatible with topcoats specified in Section 099600 “High Performance Coatings.”

2.5 FRAME ANCHORS

A. Jamb Anchors:

1. Type: Anchors of minimum size and type required by applicable door and frame standard, and suitable for performance level indicated.

2. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 0.042 inch (18 gauge) thick, with corrugated or perforated straps not less than 2 inches wide by 10 inches long; or wire anchors not less than 0.177 inch thick.
3. Quantity: Minimum of three anchors per jamb, with one additional anchor for frames with no floor anchor. Provide one additional anchor for each 24 inches of frame height above 7 feet.
4. Postinstalled Expansion Anchor Type for In-Place Concrete or Masonry: Minimum 3/8-inch- diameter bolts with expansion shields or inserts, with manufacturer's standard pipe spacer. Provide pipe spacer from frame to wall, with throat reinforcement plate, welded to frame at each anchor location.

B. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, minimum thickness of 0.042 inch.

C. Material: ASTM A879/A879M, Commercial Steel (CS), 04Z coating designation; mill phosphatized.

1. For anchors built into exterior walls, steel sheet complying with ASTM A1008/A1008M or ASTM A1011/A1011M; hot-dip galvanized according to ASTM A153/A153M, Class B.

2.6 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

B. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.

C. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B.

D. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A153/A153M.

E. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.

F. Mineral-Fiber Insulation: ASTM C665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E136 for combustion characteristics.

G. Glazing: Comply with requirements in Section 088000 "Glazing."

H. Grout: ASTM C 476, except with a maximum slump of 4 inches, as measured according to ASTM C 143/C 143M.

I. Bituminous Coating: Cold-applied asphalt mastic, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.7 FABRICATION

A. Door Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch beyond edge of door on which astragal is mounted or as required to comply with published listing of qualified testing agency.

B. Fabricate hollow-metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for metal thickness. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.

C. Hollow-Metal Doors:

1. Steel-Stiffened Door Cores(where used at manufacturer’s discretion): Provide minimum thickness 0.026 inch, steel vertical stiffeners of same material as face sheets extending full-door height, with vertical webs spaced not more than 6 inches apart. Spot weld to face sheets no more than 5 inches o.c. Fill spaces between stiffeners with glass- or mineral-fiber insulation.
2. Fire Door Cores: As required to provide fire-protection ratings indicated.
3. Vertical Edges for Single-Acting Doors: Bevel edges 1/8 inch in 2 inches.

    a. Hinge Rail Edge: 0.093 inch (2.3 mm) (12 gauge) continuous steel channel.
    b. Lock Rail Edge: 0.067 inch (1.7 mm) (14 gauge) continuous steel channel.

4. Top Edge Closures: Close top edges of doors with flush closures of same material as face sheets. Seal top edge water tight at exterior doors.

    a. 0.067-inch (1.7 mm) (16 gauge) closure at all doors.

5. Bottom Edge Closures: Close bottom edges of doors with 0.053 inch (1.3 mm) (16 gauge) thick channels of same material as face sheets. Inverted channel (legs down).
6. Exterior Doors: Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape.
7. Glazed Lites: Factory cut openings in doors.
8. Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch beyond edge of door on which astragal is mounted or as required to comply with published listing of qualified testing agency.

D. Hollow-Metal Frames: Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as frames.

1. Sidelite and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by welding.
2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
3. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted, not less than 0.016 inch (26 gauge) thick.
4. Floor Anchors: Weld anchors to bottoms of jambs with at least four spot welds per anchor; however, for slip-on drywall frames, provide anchor clips or countersunk holes at bottoms of jambs.
5. Jamb Anchors: At storm shelter openings, provide anchors to comply with FEMA 361 physical performance requirements indicated. At other openings, provide number and spacing of anchors as follows:

    a. Masonry Type: Locate anchors not more than 16 inches from top and bottom of frame. Space anchors not more than 32 inches o.c., to match coursing, and as follows:

        1) Two anchors per jamb up to 60 inches high.
        2) Three anchors per jamb from 60 to 90 inches high.
        3) Four anchors per jamb from 90 to 120 inches high.
        4) Four anchors per jamb plus one additional anchor per jamb for each 24 inches or fraction thereof above 120 inches high.

    b. Postinstalled Expansion Type: Locate anchors not more than 6 inches from top and bottom of frame. Space anchors not more than 26 inches o.c.

6. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.

    a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
    b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.

E. Fabricate concealed stiffeners and edge channels from either cold- or hot-rolled steel sheet.

F. Hardware Preparation: Factory prepare hollow-metal doors and frames to receive templated mortised hardware, and electrical wiring; include cutouts, reinforcement, mortising, drilling, and tapping according to ANSI/SDI A250.6, the Door Hardware Schedule, and templates.

1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
2. Comply with BHMA A156.115 for preparing hollow-metal doors and frames for hardware.
3. Frame Reinforcement for Exterior Openings:

    a. Hinge: Minimum 3/16 inch thick steel bar reinforcement extending continuous one piece from top to bottom of door frame; high frequency hinge reinforcement at all hinges will also be acceptable.

b. Closer/Holder: Minimum 3/16 inch by 1-1/2 inches thick steel plate extending continuous one piece, full width of opening.
c. Strike: 14 gauge steel

4. Frame Reinforcement for Interior Openings

a. Hinge: 7 gauge hinge reinforcements welded to frames, with high frequency hinge reinforcements at all hinges.
b. Strike: 14 gauge steel.
c. Closer: 3/16 inch by 1-1/2 inches by 14 inches steel plate.

5. Door Reinforcement for all Doors:

a. Closer/Holder Stop: Minimum 12 gauge tubular 5 inches by 18 inches length, or as required.
b. Other: Per Steel Door Institute Standards unless noted otherwise in this Section.

6. Additional Frame Requirements:

a. Install 1 inch by 2 inches by length required, rigid board insulation where grouted frames must be penetrated by machine or sheet metal screws for attachment of closers, rim pan strikes, or jamb weatherstripping. Attach securely with tape of adhesive.
b. Apply “Rusco Permanent Sealer” to soffits, stops, and rabbets or corner joints that will be exposed to weather.
c. Grout guard covers are to be welded in place over all drilled reinforcements of frames.

7. Coordinate locations of conduit and wiring boxes for electrical connections with Division 26 Sections.

G. Stops and Moldings: Provide stops and moldings around glazed lites and louvers where indicated. Form corners of stops and moldings with butted or mitered hairline joints.

1. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of hollow-metal work.
2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
4. Provide loose stops and moldings on inside of hollow-metal work.
5. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.
6. Mullions and Transom Bars: Join to adjacent members by welding or rigid mechanical anchors.

2.8 STEEL FINISHES

A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.

1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI/SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.

C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces. Touch up factory-applied finishes where spreaders are removed.

B. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.3 INSTALLATION

A. Install hollow-metal doors and frames plumb, rigid, properly aligned, and securely fastened in place. Comply with approved Shop Drawings and with manufacturer's written instructions.

B. Hollow-Metal Frames: Install hollow-metal frames for doors, transoms, sidelites, borrowed lites, and other openings, of size and profile indicated. Comply with ANSI/SDI A250.11or NAAMM-HMMA 840 as required by standards specified.

1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces without damage to completed Work.

    a. Where frames are fabricated in sections, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces. Touch-up finishes.
    b. Install frames with removable stops located on secure side of opening.

2. Fire-Rated Openings: Install frames according to NFPA 80.

3. Floor Anchors: Secure with postinstalled expansion anchors.

    a. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.

4. Solidly pack insulation inside exterior frames in accordance with Section 072100 “Thermal Insulation.”.
5. Masonry Walls: Coordinate installation of interior frames to allow for solidly filling space between frames and masonry with grout or mortar.
6. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
7. Installation Tolerances: Adjust hollow-metal frames to the following tolerances:

    a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
    b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
    c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
    d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.

C. Hollow-Metal Doors: Fit and adjust hollow-metal doors accurately in frames, within clearances specified below.

1. Non-Fire-Rated Steel Doors: Comply with ANSI/SDI A250.8 or NAAMM-HMMA 841 and NAAMM-HMMA guide specification indicated.

    a. Between Door and Frame Jambs and Head: 1/8 inch plus or minus 1/32 inch.
    b. Between Edges of Pairs of Doors: 1/8 inch to 1/4 inch plus or minus 1/32 inch.
    c. Between Bottom of Door and Top of Finish Floor (No Threshold): 3/4 inch maximum.
    d. Between Bottom of Door and Top of Threshold: 3/8 inch maximum.
    e. Between Door Face and Stop: 1/16 inch to 1/8 inch plus or minus 1/32 inch.

2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.

D. Glazing: Comply with installation requirements in Section 088000 "Glazing" and with hollow-metal manufacturer's written instructions.

1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches o.c. and not more than 2 inches o.c. from each corner.

3.4 FIELD QUALITY CONTROL

A. Inspection Agency: Engage a qualified inspector to perform inspections and to furnish reports to Architect.

B. Inspections:

1. Fire-Rated Door Inspections: Inspect each fire-rated door according to NFPA 80, Section 5.2.
2. Egress Door Inspections: Inspect each door equipped with panic hardware, each door equipped with fire exit hardware, each door located in an exit enclosure, each electrically controlled egress door, and each door equipped with special locking arrangements according to NFPA 101, Section 7.2.1.15.

C. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.

D. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.

E. Prepare and submit separate inspection report for each fire-rated door assembly indicating compliance with each item listed in NFPA 80.

3.5 REPAIR

A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow-metal work that is warped, bowed, or otherwise unacceptable.

B. Remove grout and other bonding material from hollow-metal work immediately after installation.

C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.

D. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

E. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

END OF SECTION 081113

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SECTION 083113 - ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes access doors and frames for walls and ceilings.

B. Related Requirements:

1. Section 087100 “Door Hardware” for lock cylinders for access doors.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details material descriptions, dimensions of individual components and profiles, and finishes.

B. Samples: For each type of access door and frame and for each finish specified, complete assembly minimum 6 by 6 inches in size.

1.4 CLOSEOUT SUBMITTALS

A. Record Documents: For fire-rated doors, list of applicable room name and number in which access door is located.

PART 2 - PRODUCTS

2.1 ACCESS DOORS AND FRAMES

A. Flush Access Doors with Exposed Flanges :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. JL Industries, Inc.; a division of the Activar Construction Products Group.

b. Karp Associates, Inc.
c. Larsens Manufacturing Company.
d. Milcor; Commercial Products Group of Hart & Cooley, Inc.
e. Nystrom, Inc.

2. Description: Face of door flush with frame, with exposed flange and concealed hinge.
3. Locations: Wall and ceiling.
4. Door Size: As indicated on Drawings.
5. Uncoated Steel Sheet for Door: Nominal 0.075 inch, 14 gage, factory primed.
6. Frame Material: Same material and finish as door, Nominal 0.060 inch (1.52 mm), 16 gage.
7. Latch and Lock: Prepared for 1-1/8 inch mortise cylinder provided by Section 087100 “Door Hardware.”

2.2 MATERIALS

A. Steel Plates, Shapes, and Bars: ASTM A36/A36M.

B. Steel Sheet: Uncoated or electrolytic zinc coated, ASTM A879/A879M, with cold-rolled steel sheet substrate complying with ASTM A1008/A1008M, Commercial Steel (CS), exposed.

C. Frame Anchors: Same material as door face.

D. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel according to ASTM A153/A153M or ASTM F2329.

2.3 FABRICATION

A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.

B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.

C. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish mounting holes, attachment devices and fasteners of type required to secure access doors to types of supports indicated.

D. Latch and Lock Hardware:

1. Quantity: Furnish number of latches required to hold doors tightly closed.
2. Retain "Mortise Cylinder Preparation" Subparagraph below if lock is not provided by access door and frame manufacturer.
3. Mortise Cylinder Preparation: Prepare door panel to accept cylinder specified in “Section 087100 "Door Hardware."

2.4 FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Noticeable variations in same piece are 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. Painted Finishes: Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

1. Factory Primed: Apply manufacturer's standard, lead- and chromate-free, universal primer immediately after surface preparation and pretreatment.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with manufacturer's written instructions for installing access doors and frames.

3.3 ADJUSTING

A. Adjust doors and hardware, after installation, for proper operation.

END OF SECTION 083113

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SECTION 083313 - COILING COUNTER DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Counter doors.

B. Related Requirements:

1. Section 087100 “Door Hardware” for lock cylinders and keys.

1.3 ACTION SUBMITTALS

A. Product Data: For each type and size of coiling counter door and accessory.

1. Include construction details, material descriptions, dimensions of individual components, profiles for slats, and finishes.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished accessories.

B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data.

1. Include plans, elevations, sections, and mounting details.
2. Include details of equipment assemblies, and indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include points of attachment and their corresponding static and dynamic loads imposed on structure.
4. Include diagrams for power, signal, and control wiring.

C. Samples for Initial Selection: Manufacturer's finish charts showing full range of colors and textures available for units with factory-applied finishes.

1. Include similar Samples of accessories involving color selection.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For coiling counter doors to include in maintenance manuals.

B. Record Documents: For fire-rated doors, list of door numbers and applicable room name and number to which door accesses.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer for both installation and maintenance of units required for this Project.

1. Maintenance Proximity: Not more than two hours' normal travel time from Installer's place of business to Project site.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain coiling counter doors from single source from single manufacturer.

1. Obtain operators and controls from coiling counter door manufacturer.

2.2 COUNTER DOOR ASSEMBLY

A. Counter Door: Coiling counter door formed with curtain of interlocking metal slats.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Cornell Iron Works, Inc.; ESC10 Rolling Counter Door or comparable product by one of the following:

a. Cookson Company.
b. Overhead Door Corporation.

B. Operation Cycles: Door components and operators capable of operating for not less than 20,000. One operation cycle is complete when a door is opened from the closed position to the fully open position and returned to the closed position.

C. Door Curtain Material: Galvanized steel.

D. Door Curtain Slats: Flat profile slats of 1-1/2-inch center-to-center height.

E. Bottom Bar: Manufacturer's standard continuous channel or tubular shape, fabricated hot-dip galvanized steel and finished to match door.

F. Curtain Jamb Guides: Galvanized steel with exposed finish matching curtain slats. Provide continuous integral wear strips to prevent metal-to-metal contact and to minimize operational noise.

G. Hood: Match curtain material and finish.

1. Shape: Square.
2. Mounting: Face of wall.

H. Electric Door Operator:

1. Usage Classification: Standard duty, up to 25 cycles per hour and up to 90 cycles per day.
2. Operator Location: Front of hood.
3. Motor Exposure: Interior.
4. Motor Electrical Characteristics:

a. Horsepower: 1/2 hp.
b. Voltage: 115-V ac, single phase, 60 Hz.

5. Emergency Manual Operation: Push-up type.
6. Obstruction-Detection Device: Automatic electric sensor edge on bottom bar ; self-monitoring type.

a. Sensor Edge Bulb Color: Black.

7. Control Station(s): Interior-side mounted.

I. Curtain Accessories: Equip door with astragal.

J. Door Finish:

1. Powder-Coated Finish: Color as selected by Architect from manufacturer's full range.

2.3 MATERIALS, GENERAL

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.4 DOOR CURTAIN MATERIALS AND CONSTRUCTION

A. Door Curtains: Fabricate coiling counter door curtain of interlocking metal slats in a continuous length for width of door without splices. Unless otherwise indicated, provide slats of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of door indicated, and as follows:

1. Steel Door Curtain Slats: Zinc-coated (galvanized), cold-rolled structural-steel sheet; complying with ASTM A653/A653M, with G90 zinc coating; nominal sheet thickness (coated) of 0.028 inch; and as required.

B. Curtain Jamb Guides: Manufacturer's standard angles or channels and angles of same material and finish as curtain slats unless otherwise indicated, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Slot bolt holes for guide adjustment. Provide removable stops on guides to prevent overtravel of curtain.

2.5 HOODS

A. General: Form sheet metal hood to entirely enclose coiled curtain and operating mechanism at opening head. Contour to fit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Form closed ends for surface-mounted hoods and fascia for any portion of between-jamb mounting that projects beyond wall face. Equip hood with intermediate support brackets as required to prevent sagging.

1. Galvanized Steel: Nominal 0.028-inch- thick, hot-dip galvanized-steel sheet with G90 zinc coating, complying with ASTM A653/A653M.

2.6 LOCKING DEVICES

A. Locking Device Assembly: Fabricate with cylinder lock, spring-loaded dead bolt, operating handle, cam plate, and adjustable locking bars to engage through slots in tracks.

1. Lock Cylinders: As specified in Section 087100 "Door Hardware".

B. Safety Interlock Switch: Equip power-operated doors with safety interlock switch to disengage power supply when door is locked.

2.7 CURTAIN ACCESSORIES

A. Astragal: Equip each door bottom bar with a replaceable, adjustable, continuous, compressible gasket of flexible vinyl, rubber, or neoprene as a cushion bumper.

2.8 COUNTERBALANCE MECHANISM

A. General: Counterbalance doors by means of manufacturer's standard mechanism with an adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to top of curtain with barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.

B. Counterbalance Barrel: Fabricate spring barrel of manufacturer's standard hot-formed, structural-quality, seamless or welded carbon-steel pipe, of sufficient diameter and wall thickness to support rolled-up curtain without distortion of slats and to limit barrel deflection to not more than 0.03 in./ft. of span under full load.

C. Counterbalance Spring: One or more oil-tempered, heat-treated steel helical torsion springs. Size springs to counterbalance weight of curtain, with uniform adjustment accessible from outside barrel. Secure ends of springs to barrel and shaft with cast-steel barrel plugs.

D. Torsion Rod for Counterbalance Shaft: Fabricate of manufacturer's standard cold-rolled steel, sized to hold fixed spring ends and carry torsional load.

E. Brackets: Manufacturer's standard mounting brackets of either cast iron or cold-rolled steel plate.

2.9 ELECTRIC DOOR OPERATORS

A. General: Electric door operator assembly of size and capacity recommended and provided by door manufacturer for door and operation-cycles requirement specified, with electric motor and factory-prewired motor controls, starter, gear-reduction unit, solenoid-operated brake, clutch, control stations, control devices, integral gearing for locking door, and accessories required for proper operation.

1. Comply with NFPA 70.
2. Control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6, with NFPA 70 Class 2 control circuit, maximum 24-V ac or dc.

B. Usage Classification: Electric operator and components capable of operating for not less than number of cycles per hour indicated for each door.

C. Door Operator Location(s): Operator location indicated for each door.

1. Front-of-Hood Mounted: Operator is mounted to the right or left door head plate with the operator on coil side of the door-hood assembly and connected to the door drive shaft with drive chain and sprockets. Front clearance is required for this type of mounting.

D. Motors: Reversible-type motor with controller (disconnect switch) for motor exposure indicated for each door assembly.

1. Electrical Characteristics: Minimum as indicated for each door assembly. If not indicated, large enough to start, accelerate, and operate door in either direction from any position, at a speed not less than 8 in./sec. and not more than 12 in./sec., without exceeding nameplate ratings or service factor.
2. Operating Controls, Controllers, Disconnect Switches, Wiring Devices, and Wiring: Manufacturer's standard unless otherwise indicated.
3. Coordinate wiring requirements and electrical characteristics of motors and other electrical devices with building electrical system and each location where installed.

E. Limit Switches: Equip each motorized door with adjustable switches interlocked with motor controls and set to automatically stop door at fully opened and fully closed positions.

F. Obstruction-Detection Devices: External entrapment protection consisting of indicated automatic safety sensor capable of protecting full width of door opening. For non-fire-rated doors, activation of device immediately stops and reverses downward door travel.

1. Electric Sensor Edge: Automatic safety sensor edge, located within astragal mounted to bottom bar. Contact with sensor activates device. Connect to control circuit using manufacturer's standard take-up reel or self-coiling cable.

    a. Self-Monitoring Type: Four-wire-configured device designed to interface with door operator control circuit to detect damage to or disconnection of sensor edge.

G. Control Station: Three-button control station in fixed location with momentary-contact push-button controls labeled "Open" and "Stop" and sustained- or constant-pressure push-button control labeled "Close."

1. Type: Full-guarded, surface-mounted, heavy-duty type, with general-purpose NEMA ICS 6, Type 1 enclosure.

H. Emergency Manual Operation: Equip each electrically powered door with capability for emergency manual operation. Design manual mechanism so required force for door operation does not exceed 25 lbf.

I. Emergency Operation Disconnect Device: Equip operator with hand-operated disconnect mechanism for automatically engaging manual operator and releasing brake for emergency manual operation while disconnecting motor without affecting timing of limit switch. Mount mechanism so it is accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.

J. Motor Removal: Design operator so motor may be removed without disturbing limit-switch adjustment and without affecting emergency manual operation.

2.10 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM/NOMMA 500 for recommendations for applying and designating finishes.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.11 STEEL AND GALVANIZED-STEEL FINISHES

A. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates areas and conditions, with Installer present, for compliance with requirements for substrate construction and other conditions affecting performance of the Work.

B. Examine locations of electrical connections.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install coiling counter doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.

B. Install coiling counter doors, hoods, controls, and operators at the mounting locations indicated for each door.

3.3 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. After electrical circuitry has been energized, operate doors to confirm proper motor rotation and door performance.
3. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

3.4 ADJUSTING

A. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.

B. Lubricate bearings and sliding parts as recommended by manufacturer.

C. Adjust seals to provide tight fit around entire perimeter.

3.5 MAINTENANCE SERVICE

A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by skilled employees of coiling-door Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

1. Perform maintenance, including emergency callback service, during normal working hours.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain coiling counter doors.

END OF SECTION 083313

SECTION 084113 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Exterior Storefront framing.
2. Exterior manual-swing entrance doors and door frame units.

B. Related Requirements:

1. Section 079200 “Joint Sealants” for installation of joint sealants installed to the extent not specified in this Section.
2. Section 087100 “Door hardware” for hardware items not provided by this Section.”
3. Section 088000 “Glazing.”
4. Divisions 26 and 28 and Electrical Drawings for frames requiring electrical connections.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: For aluminum-framed entrances and storefronts. Include plans, elevations, sections, full-size details, and attachments to other work.

1. Include details of provisions for assembly expansion and contraction and for draining moisture occurring within the assembly to the exterior.
2. Show connection to and continuity with adjacent thermal, weather, air, and vapor barriers.
3. Include point-to-point wiring diagrams showing the following:

a. Power requirements for each electrically operated door hardware.
b. Location and types of switches, signal device, conduit sizes, and number and size of wires.

C. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.

D. Entrance Door Hardware Schedule: Prepared by or under supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams. Coordinate final entrance door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of entrance door hardware.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Energy Performance Certificates: For aluminum-framed entrances and storefronts, accessories, and components, from manufacturer.

1. Basis for Certification: NFRC-certified energy performance values for each aluminum-framed entrance and storefront.

C. Field quality-control reports.

D. Sample Warranties: For special warranties.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For aluminum-framed entrances and storefronts to include in maintenance manuals.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

B. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.

1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

1.8 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of aluminum-framed entrances and storefronts that do not comply with requirements or that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures, including, but not limited to, excessive deflection.
b. Noise or vibration created by wind and thermal and structural movements.
c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
d. Water penetration through fixed glazing and framing areas.
e. Failure of operating components.

2. Warranty Period: Three years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain all components of aluminum-framed entrance and storefront system, including framing and accessories, from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. General Performance: Comply with performance requirements specified, as determined by testing of aluminum-framed entrances and storefronts representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.

1. Aluminum-framed entrances and storefronts shall withstand movements of supporting structure, including, but not limited to, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
2. Failure also includes the following:

a. Thermal stresses transferring to building structure.
b. Glass breakage.
c. Noise or vibration created by wind and thermal and structural movements.
d. Loosening or weakening of fasteners, attachments, and other components.
e. Failure of operating units.

B. Structural Loads:

1. Wind Loads: As indicated on Structural Drawings.

C. Deflection of Framing Members: At design wind pressure, as follows:

1. Deflection Normal to Wall Plane: Limited to edge of glass in a direction perpendicular to glass plane not exceeding 1/175 of the glass edge length for each individual glazing lite or an amount that restricts edge deflection of individual glazing lites to 3/4 inch, whichever is less.
2. Deflection Parallel to Glazing Plane: Limited to 1/360 of clear span or 1/8 inch, whichever is smaller.

D. Structural: Test according to ASTM E330/E330M as follows:

1. When tested at positive and negative wind-load design pressures, storefront assemblies, including entrance doors, do not evidence deflection exceeding specified limits.
2. When tested at 150 percent of positive and negative wind-load design pressures, storefront assemblies, including entrance doors and anchorage, do not evidence material failures, structural distress, or permanent deformation of main framing members exceeding 0.2 percent of span.
3. Test Durations: As required by design wind velocity, but not less than 10 seconds.

E. Air Infiltration: Test according to ASTM E283 for infiltration as follows:

1. Fixed Framing and Glass Area:

    a. Maximum air leakage of 0.06 cfm/sq. ft. at a static-air-pressure differential of 6.24 lbf/sq. ft..

2. Entrance Doors:

    a. Single Doors: Maximum air leakage of 0.5 cfm/sq. ft. at a static-air-pressure differential of 1.57 lbf/sq. ft. (75 Pa).
    b. Pair of Doors: Maximum air leakage of 1.0 cfm/sq. ft. (5.08 L/s per sq. m) at a static air pressure differential of 1.57 lbf/sq. ft. (75 Pa).

F. Water Penetration under Static Pressure: Test according to ASTM E331 as follows:

1. No evidence of water penetration through fixed glazing and framing areas, including entrance doors, when tested according to a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 10 lbf/sq. ft..

G. Energy Performance: Certify and label energy performance according to NFRC as follows:

1. Thermal Transmittance (U-factor): Fixed glazing and framing areas as a system shall have U-factor of not more than 0.45 Btu/sq. ft. x h x deg F as determined according to NFRC 100.
2. Solar Heat Gain Coefficient (SHGC): Fixed glazing and framing areas as a system shall have SHGC of no greater than 0.25 as determined according to NFRC 200.
3. Condensation Resistance: Fixed glazing and framing areas as a system shall have an NFRC-certified condensation resistance rating of no less than 51 as determined according to NFRC 500.

H. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.3 STOREFRONT SYSTEMS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Kawneer North America; an Alcoa company products or comparable product by one of the following:

1. EFCO Corporation.
2. Manko Window Systems, Inc.
3. Tubelite Inc.

B. Basis-of-Design Storefront Products, Kawneer:

1. Exterior Entrance Doors: 500 Standard Entrance Doors.
2. Exterior Framing for Entrances and Storefront: Trifab® VersaGlaze® 451T Framing System, 2 inch sightline by 4-1/2 inches deep framing.

C. Source Limitations: Obtain all components of aluminum-framed entrance and storefront system, including framing and accessories, from single manufacturer.

D. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.

1. Exterior Framing Construction: Thermally broken
2. Glazing System: Retained mechanically with gaskets on four sides .
3. Glazing Plane: Center.
4. Finish: Color anodic finish.
5. Fabrication Method: Field-fabricated stick system.
6. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
7. Steel Reinforcement: As required by manufacturer.
8. Fabrication Method: Field-fabricated stick system.

E. Backer Plates: Manufacturer's standard, continuous backer plates for framing members, if not integral, where framing abuts adjacent construction.

F. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

2.4 ENTRANCE DOOR SYSTEMS

A. Entrance Doors: Manufacturer's standard glazed entrance doors for manual-swing or automatic operation.

1. Door Construction: 1-3/4-inch overall thickness, with minimum 0.125-inch-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: Wide stile; 5-inch nominal width.

    a. Top Rail: 8 inch minimum.
    b. Mid Rail: 8 inch.
    c. Bottom Rail: Smooth surfaced for width of door in area within 10 inches (255 mm) above floor or ground plane in accordance with ADA Standard.

3. Glazing Stops and Gaskets: Square, snap-on, extruded-aluminum stops and preformed gaskets.

    a. Provide nonremovable glazing stops on outside of door.

2.5 ENTRANCE DOOR HARDWARE

A. Entrance Door Hardware: Hardware not specified in this Section is specified in Section 087100 "Door Hardware."

B. General: Provide entrance door hardware for each entrance door, to comply with requirements in this Section.

C. Cylinders: As specified in Section 087100 "Door Hardware."

D. Weather Stripping: Manufacturer's standard replaceable components.

1. Compression Type: Made of ASTM D2000 molded neoprene or ASTM D2287 molded PVC.
2. Sliding Type: AAMA 701/702, made of wool, polypropylene, or nylon woven pile with nylon-fabric or aluminum-strip backing.

2.6 GLAZING

A. Glazing: Comply with Section 088000 "Glazing."

B. Glazing Gaskets: Manufacturer's standard sealed-corner pressure-glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers.

C. Glazing Sealants: Comply with Section 088000 "Glazing."

1. Verify sealant has a VOC content of 250 g/L or less.

2.7 MATERIALS

A. Sheet and Plate: ASTM B209.

B. Extruded Bars, Rods, Profiles, and Tubes: ASTM B221.

C. Extruded Structural Pipe and Tubes: ASTM B429/B429M.

D. Structural Profiles: ASTM B308/B308M.

1. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.

a. Sheet and Plate: ASTM B 209.
b. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221.
c. Extruded Structural Pipe and Tubes: ASTM B 429/B 429M.
d. Structural Profiles: ASTM B 308/B 308M.

E. Steel Reinforcement:

1. Structural Shapes, Plates, and Bars: ASTM A36/A36M.
2. Cold-Rolled Sheet and Strip: ASTM A1008/A1008M.
3. Hot-Rolled Sheet and Strip: ASTM A1011/A1011M.
4. Primer: Manufacturer's standard zinc-rich, corrosion-resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM, and prepare surfaces according to applicable SSPC standard.

2.8 ACCESSORIES

A. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.

1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
2. Reinforce members as required to receive fastener threads.

B. Anchors: Three-way adjustable anchors with minimum adjustment of 1 inch that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by manufacturer.

1. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A123/A123M or ASTM A153/A153M requirements.

C. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.

D. Bituminous Paint: Cold-applied asphalt-mastic paint containing no asbestos, formulated for 30-mil thickness per coat.

2.9 FABRICATION

A. Form or extrude aluminum shapes before finishing.

B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

C. Fabricate components that, when assembled, have the following characteristics:

1. Profiles that are sharp, straight, and free of defects or deformations.
2. Accurately fitted joints with ends coped or mitered.
3. Means to drain water passing joints, condensation within framing members, and moisture migrating within the system to exterior.
4. Physical and thermal isolation of glazing from framing members.
5. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
6. Provisions for field replacement of glazing from exterior or interior.
7. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.

D. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.

E. Storefront Framing: Fabricate components for assembly using screw-spline system .

F. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware. Provide 1/4 inch (6 mm) thick by width of frame by length required backup aluminum plate inside door frames where surface mounted hardware is attached.

1. At interior and exterior doors, provide compression weather stripping at fixed stops.

G. Entrance Doors: Reinforce doors as required for installing entrance door hardware. Provide 1/4 inch (6 mm) thick by size required backup aluminum plate inside doors where surface mounted hardware is attached.

1. At pairs of exterior doors, provide sliding-type weather stripping retained in adjustable strip and mortised into door edge.
2. At exterior doors, provide weather sweeps applied to door bottoms.

H. Entrance Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.

I. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.10 ALUMINUM FINISHES

A. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or thicker.

1. Color: Dark bronze.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General:

1. Comply with manufacturer's written instructions.
2. Do not install damaged components.
3. Fit joints to produce hairline joints free of burrs and distortion.
4. Rigidly secure nonmovement joints.
5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
6. Seal perimeter and other joints watertight unless otherwise indicated.

B. Metal Protection:

1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with materials recommended by manufacturer for this purpose or by installing nonconductive spacers.
2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

C. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.

D. Set continuous sill members and flashing in full sealant bed, as specified in Section 079200 "Joint Sealants," to produce weathertight installation.

E. Install components plumb and true in alignment with established lines and grades.

F. Install glazing as specified in Section 088000 "Glazing."

G. Entrance Doors: Install doors to produce smooth operation and tight fit at contact points.

1. Exterior Doors: Install to produce weathertight enclosure and tight fit at weather stripping.
2. Field-Installed Entrance Door Hardware: Install surface-mounted entrance door hardware according to entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.

H. Install perimeter joint sealants as specified in Section 079200 “Joint Sealants” to produce weathertight installation.

3.3 ERECTION TOLERANCES

A. Erection Tolerances: Install aluminum-framed entrances and storefronts to comply with the following maximum tolerances:

1. Plumb: 1/8 inch in 10 feet; 1/4 inch in 40 feet.
2. Level: 1/8 inch in 20 feet; 1/4 inch in 40 feet.
3. Alignment:

    a. Where surfaces abut in line or are separated by reveal or protruding element up to 1/2 inch wide, limit offset from true alignment to 1/16 inch.
    b. Where surfaces are separated by reveal or protruding element from 1/2 to 1 inch wide, limit offset from true alignment to 1/8 inch.
    c. Where surfaces are separated by reveal or protruding element of 1 inch wide or more, limit offset from true alignment to 1/4 inch.

4. Location: Limit variation from plane to 1/8 inch in 12 feet; 1/2 inch over total length.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Field Quality-Control Testing: Perform the following test on representative areas of aluminum-framed entrances and storefronts.

1. Water-Spray Test: Before installation of interior finishes has begun, areas designated by Architect shall be tested according to AAMA 501.2 and shall not evidence water penetration.

    a. Perform a minimum of two tests in areas as directed by Architect.

C. Aluminum-framed entrances and storefronts will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

END OF SECTION 084113

SECTION 085113 - ALUMINUM WINDOWS

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 aluminum windows for exterior locations.

B. Related Requirements:

1. Section 084113 "Aluminum-Framed Entrances and Storefronts" for coordinating finish among aluminum fenestration units.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
2. Review and discuss the finishing of aluminum windows that is required to be coordinated with the finishing of other aluminum work for color and finish matching.
3. Review, discuss, and coordinate the interrelationship of aluminum windows with other exterior wall components. Include provisions for anchoring, flashing, weeping, sealing perimeters, and protecting finishes.
4. Review and discuss the sequence of work required to construct a watertight and weathertight exterior building envelope.
5. Inspect and discuss the condition of substrate and other preparatory work performed by other trades.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, glazing and fabrication methods, dimensions of individual components and profiles, hardware, and finishes for aluminum windows.

B. Shop Drawings: For aluminum windows.

1. Include plans, elevations, sections, hardware, accessories, insect screens, operational clearances, and details of installation, including anchor, flashing, and sealant installation.

C. Samples: For each exposed product and for each color specified, 2 by 4 inches in size.

D. Product Schedule: For aluminum windows. Use same designations indicated on Drawings.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and Installer.

B. Field quality-control reports.

C. Sample Warranties: For manufacturer's warranties.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: A manufacturer capable of fabricating aluminum windows that meet or exceed performance requirements indicated and of documenting this performance by test reports and calculations.

B. Installer Qualifications: An installer acceptable to aluminum window manufacturer for installation of units required for this Project.

1.7 WARRANTY

A. Manufacturer's Warranty: 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: 10 years from date of Substantial Completion.
b. Glazing Units: 10 years from date of Substantial Completion.
c. Aluminum Finish: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain aluminum windows from single source from single manufacturer.

2.2 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 as follows:

1. Minimum Performance Class: AW.
2. Minimum Performance Grade: 40.

C. Thermal Transmittance: NFRC 100 maximum whole-window U-factor of 0.43 Btu/sq. ft. x h x deg F.

D. Solar Heat-Gain Coefficient (SHGC): NFRC 200 maximum whole-window SHGC of 0.40.

E. Condensation-Resistance Factor (CRF): Provide aluminum windows tested for thermal performance according to AAMA 1503, showing a CRF of 60.

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 deg F ambient; 180 deg F material surfaces.

2.3 ALUMINUM WINDOWS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Kawneer North America; an Alcoa company; OptiQ®AA®4325 Series Windows or comparable product by one of the following:

1. EFCO Corporation; Series 325X.
2. Manko Window Systems, Inc.; 3232xpt Series.
3. Wausau Window and Wall Systems; Apogee Wausau Group; 3250i Invent Series.
4. YKK AP America Inc.; YOW 350 XT.

B. Frames Depth: 3-1/4 inches (82.6 mm) minimum.

C. Types: Provide the following types in locations indicated on Drawings:

1. Fixed.

D. Frames: Aluminum extrusions complying with AAMA/WDMA/CSA 101/I.S.2/A440.

1. Thermally Improved Construction: Fabricate frames, 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. Insulating-Glass Units: Refer to Section 088000 “Glazing” for insulated glass units and glazing requirements applicable to glazed aluminum window units.

F. Glazing System: Manufacturer's standard factory-glazing system that produces weathertight seal.

G. Fasteners: Noncorrosive and compatible with window members, trim, hardware, anchors, and other components.

1. Exposed Fasteners: Do not use exposed fasteners to greatest extent possible. For application of hardware, use fasteners that match finish hardware being fastened.

2.4 ACCESSORIES

A. Subsills: Thermally broken, extruded-aluminum subsills in configurations indicated on Drawings.

1. Provide extensions clipped to frame and with anchor clip at face brick. Subsill extensions to extend over face of wall as indicated

B. .

2.5 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.

2.6 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "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.

2.7 ALUMINUM FINISHES

A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

B. Class I, Color Anodic Finish: AA-M12C22A42/A44 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker) complying with AAMA 611.

1. Color: Dark bronze.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, 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 only after unsatisfactory conditions have been corrected.

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 E2112.

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.

3.3 FIELD QUALITY CONTROL

A. Testing Agency: 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 according to AAMA 502.
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.

D. Prepare test and inspection reports.

3.4 ADJUSTING, CLEANING, AND PROTECTION

A. 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.

B. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.

C. 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 085113

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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 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes:

1. Mechanical and electrified door hardware for:

a. Swinging doors.

2. The intent of the hardware specification is to specify the hardware for interior and exterior doors, and to establish a type, continuity, and standard of quality. However, it is the door hardware supplier's responsibility to thoroughly review existing conditions, schedules, specifications, drawings, and other Contract Documents to verify the suitability of the hardware specified.

B. Exclusions: Unless specifically listed in hardware sets, hardware is not specified in this section for:

1. Windows
2. Cabinets (casework), including locks in cabinets
3. Signage
4. Toilet accessories
5. Overhead doors
6. Shower doors
7. Access doors and panels

C. Related Sections:

1. Division 07 Section "Joint Sealants" for sealant requirements applicable to threshold installation specified in this section.
2. Division 08 Section "Aluminum Storefront and Entrances" for hardware requirements applicable to installation of hardware to entrance doors
3. Division 09 sections for touchup, finishing or refinishing of existing openings modified by this section.
4. Division 26 sections for connections to electrical power system and for low-voltage wiring.
5. Division 28 sections for coordination with other components of electronic access control system.

1.3 REFERENCES

A. UL - Underwriters Laboratories

1. UL 10B - Fire Test of Door Assemblies
2. UL 10C - Positive Pressure Test of Fire Door Assemblies
3. UL 1784 - Air Leakage Tests of Door Assemblies
4. UL 305 - Panic Hardware

B. DHI - Door and Hardware Institute

1. Sequence and Format for the Hardware Schedule
2. Recommended Locations for Builders Hardware
3. Key Systems and Nomenclature

C. ANSI - American National Standards Institute

1. ANSI/BHMA A156.1 - A156.29, and ANSI/BHMA A156.31 - Standards for Hardware and Specialties

D. NFPA – National Fire Protection Association

1. NFPA 70 – National Electrical Code
2. NFPA 80 – Fire Doors and Windows
3. NFPA 105 – Smoke and Draft Control Door Assemblies
4. NFPA 252 – Fire Test of Door Assemblies

E. WHI – Warnock Hersey Incorporated

F. SDI – Steel Door Institute

G. WI – Woodwork Institute

H. AWI – Architectural Woodwork Institute

I. NAAMM – National Association of Architectural Metal Manufacturers

J. Local applicable codes

1.4 SUBMITTALS

A. General:

1. Submit in accordance with Conditions of Contract and Division 01 requirements.
2. Highlight, encircle, or otherwise specifically identify on submittals deviations from Contract Documents, issues of incompatibility or other issues which may detrimentally affect the Work.
3. Prior to forwarding submittal, comply with procedures for verifying existing door and frame compatibility for new hardware, as specified in PART 3, “EXAMINATION” article,

herein.

B. Action Submittals:

1. Product Data: Technical product data for each item of door hardware, installation instructions, maintenance of operating parts and finish, and other information necessary to show compliance with requirements.
2. Samples for Verification: If requested by Architect, submit production sample or sample installations of each type of exposed hardware unit in finish indicated, and tagged with full description for coordination with schedule.

    a. Samples will be returned to supplier. Units that are acceptable to Architect may, after final check of operations, be incorporated into Work, within limitations of key coordination requirements.

3. Door Hardware Schedule: Submit schedule with hardware sets in vertical format as illustrated by Sequence of Format for the Hardware Schedule as published by the Door and Hardware Institute. Indicate complete designations of each item required for each door or opening, include:

    a. Door Index; include door number, heading number, and Architects hardware set number.
    b. Opening Lock Function Spreadsheet: List locking device and function for each opening.
    c. Quantity, type, style, function, size, and finish of each hardware item.
    d. Name and manufacturer of each item.
    e. Fastenings and other pertinent information.
    f. Location of each hardware set cross-referenced to indications on Drawings.
    g. Explanation of all abbreviations, symbols, and codes contained in schedule.
    h. Mounting locations for hardware.
    i. Door and frame sizes and materials.
    j. Name and phone number for local manufacturer's representative for each product.
    k. Operational Description of openings with any electrified hardware (locks, exits, electromagnetic locks, electric strikes, automatic operators, door position switches, magnetic holders or closer/holder units, and access control components). Operational description should include operational descriptions for: egress, ingress (access), and fire/smoke alarm connections.

        1) Submittal Sequence: Submit door hardware schedule concurrent with submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate fabrication of other work that is critical in Project construction schedule.

4. Key Schedule:

    a. After Keying Conference, provide keying schedule listing levels of keying as well as explanation of key system's function, key symbols used and door numbers controlled.
    b. Provide 3 copies of keying schedule for review prepared and detailed in accordance

with referenced DHI publication. Include schematic keying diagram and index each key to unique door designations.

c. Index keying schedule by door number, keyset, hardware heading number, cross keying instructions, and special key stamping instructions.

d. Provide one complete bitting list of key cuts and one key system schematic illustrating system usage and expansion.

1) Forward bitting list, key cuts and key system schematic directly to Owner, by means as directed by Owner.

e. Prepare key schedule by or under supervision of supplier, detailing Owner's final keying instructions for locks.

5. Templates: After final approval of hardware schedule, provide templates for doors, frames and other work specified to be factory or shop prepared for door hardware installation.

C. Informational Submittals:

1. Qualification Data: For Supplier, Installer and Architectural Hardware Consultant.
2. Product data for electrified door hardware:

a. Certify that door hardware approved for use on types and sizes of labeled fire-rated doors complies with listed fire-rated door assemblies.

3. Certificates of Compliance:

a. UL listings for fire-rated hardware and installation instructions if requested by Architect or Authority Having Jurisdiction.

b. Installer Training Meeting Certification: Letter of compliance, signed by Contractor, attesting to completion of installer training meeting specified in "QUALITY ASSURANCE" article, herein.

c. Electrified Hardware Coordination Conference Certification: Letter of compliance, signed by Contractor, attesting to completion of electrified hardware coordination conference, specified in "QUALITY ASSURANCE" article, herein.

4. Warranty: Special warranty specified in this Section.

D. Closeout Submittals:

1. Operations and Maintenance Data: Provide in accordance with Division 01 and include:

a. Complete information on care, maintenance, and adjustment; data on repair and replacement parts, and information on preservation of finishes.

b. Catalog pages for each product.

c. Factory order acknowledgement numbers (for warranty and service)

d. Name, address, and phone number of local representative for each manufacturer.

e. Parts list for each product.

f. Final approved hardware schedule, edited to reflect conditions as-installed.

g. Final keying schedule

h. Copies of floor plans with keying nomenclature

i. As-installed wiring diagrams for each opening connected to power, both low voltage and 110 volts.
j. Copy of warranties including appropriate reference numbers for manufacturers to identify project.

1.5 QUALITY ASSURANCE

A. If discrepancy between drawings and scheduled material in this section, bid the more expensive of the two choices, note the discrepancy in the submittal and request direction from Architect for resolution.

B. Supplier Qualifications and Responsibilities: Recognized architectural hardware supplier with record of successful in-service performance for supplying door hardware similar in quantity, type, and quality to that indicated for this Project and that provides certified Architectural Hardware Consultant (AHC) available to Owner, Architect, and Contractor, at reasonable times during the Work for consultation.

1. Warehousing Facilities: In Project's vicinity.
2. Scheduling Responsibility: Preparation of door hardware and keying schedules.
3. Coordination Responsibility: Assist in coordinating installation of electronic security hardware with Architect and electrical engineers and provide installation and technical data to Architect and other related subcontractors.

C. Architectural Hardware Consultant Qualifications: Person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and meets these requirements:

1. For door hardware, DHI-certified, Architectural Hardware Consultant (AHC).
2. Can provide installation and technical data to Architect and other related subcontractors.
3. Can inspect and verify components are in working order upon completion of installation.
4. Capable of coordinating installation of electrified hardware with Architect and electrical engineers.

D. Single Source Responsibility: Obtain each type of door hardware from single manufacturer.

1. Bid and submit manufacturer’s updated/improved item if scheduled item is discontinued.

E. Fire-Rated Door Openings: Provide door hardware for fire-rated openings that complies with NFPA 80 and requirements of authorities having jurisdiction. Provide only items of door hardware that are listed products tested by Underwriters Laboratories, Intertek Testing Services, or other testing and inspecting organizations acceptable to authorities having jurisdiction for use on types and sizes of doors indicated, based on testing at positive pressure and according to NFPA 252 or UL 10C and in compliance with requirements of fire-rated door and door frame labels.

F. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction.

G. Accessibility Requirements: For door hardware on doors in an accessible route, comply with

governing accessibility regulations cited in “REFERENCES” article, herein.

H. Keying Conference

1. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including:

    a. Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
    b. Preliminary key system schematic diagram.
    c. Requirements for key control system.
    d. Requirements for access control.
    e. Address for delivery of keys.

I. Pre-installation Conference

1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
2. Inspect and discuss preparatory work performed by other trades.
3. Inspect and discuss electrical roughing-in for electrified door hardware.
4. Review sequence of operation for each type of electrified door hardware.
5. Review required testing, inspecting, and certifying procedures.

J. Coordination Conferences:

1. Installation Coordination Conference: Prior to hardware installation, schedule and hold meeting to review questions or concerns related to proper installation and adjustment of door hardware.
2. Electrified Hardware Coordination Conference: Prior to ordering electrified hardware, schedule and hold meeting to coordinate door hardware with security, electrical, doors and frames, and other related suppliers.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up for hardware delivered to Project site.

B. Tag each item or package separately with identification coordinated with final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package.

1. Deliver each article of hardware in manufacturer’s original packaging.

C. Project Conditions:

1. Maintain manufacturer-recommended environmental conditions throughout storage and installation periods.
2. Provide secure lock-up for door hardware delivered to Project. Control handling and installation of hardware items so that completion of Work will not be delayed by hardware

losses both before and after installation.

D. Protection and Damage:

1. Promptly replace products damaged during shipping.
2. Handle hardware in manner to avoid damage, marring, or scratching. Correct, replace or repair products damaged during Work.
3. Protect products against malfunction due to paint, solvent, cleanser, or any chemical agent.

E. Deliver keys and permanent cores to Owner by registered mail or overnight package service.

1.7 COORDINATION

A. Coordinate layout and installation of floor-recessed door hardware with floor construction. Cast anchoring inserts into concrete.

B. Installation Templates: Distribute for doors, frames, and other work specified to be factory or shop prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

C. Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant.

D. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.

E. Existing Openings: Where existing doors, frames and/or hardware are to remain, field verify existing functions, conditions and preparations and coordinate to suit opening conditions and to provide proper door operation. If conflict between the specified/scheduled hardware and existing conditions, submit request for direction from Architect. Include date of jobsite visit in the submittal.

1.8 WARRANTY

A. Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Beginning from date of Substantial Completion, for durations indicated.

a. Closers:

1) Mechanical: 30 years

b. Exit Devices:

1) Mechanical: 3 years.
2) Electrified: 1 year.

c. Locksets:

1) Mechanical: 3 years.
2) Electrified: 1 year.

d. Key Blanks: Lifetime

2. Warranty does not cover damage or faulty operation due to improper installation, improper use or abuse.

1.9 MAINTENANCE

A. Maintenance Tools: Furnish complete set of special tools required for maintenance and adjustment of hardware, including changing of cylinders.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. The Owner requires use of certain products for their unique characteristics and project suitability to insure continuity of existing and future performance and maintenance standards. After investigating available product offerings, the Awarding Authority has elected to prepare proprietary specifications. These products are specified with the notation: “No Substitute.”

1. Where “No Substitute” is noted, substitution requests for other products will not be considered.

B. Approval of manufacturers and/or products other than those listed as “Scheduled Manufacturer” shall be in accordance with substitution procedure in division 01 25 00. In the individual article for the product category items, shall be in accordance with the QUALITY ASSURANCE article, herein.

C. Approval of products is contingent upon those products providing all functions and features and meeting all requirements of scheduled manufacturer’s product.

D. Where specified hardware is not adaptable to finished shape or size of members requiring hardware, furnish suitable types having same operation and quality as type specified, subject to Architect's approval in accordance with substitution procedure in division 012500.

2.2 MATERIALS

A. Fasteners

1. Provide hardware manufactured to conform to published templates, generally prepared for machine screw installation.
2. Furnish screws for installation with each hardware item. Finish exposed (exposed under any condition) screws to match hardware finish, or, if exposed in surfaces of other work,

to match finish of this other work including prepared for paint surfaces to receive painted finish.

3. Provide concealed fasteners for hardware units exposed when door is closed except when no standard units of type specified are available with concealed fasteners. Do not use thru-bolts for installation where bolt head or nut on opposite face is exposed in other work unless thru-bolts are required to fasten hardware securely. Review door specification and advise Architect if thru-bolts are required.
4. Install hardware with fasteners provided by hardware manufacturer.

B. Provide screws, bolts, expansion shields, drop plates and other devices necessary for hardware installation.

1. Where fasteners are exposed to view: Finish to match adjacent door hardware material.

C. Cable and Connectors: Hardwired Electronic Access Control Lockset and Exit Device Trim:

1. Data: 24AWG, 4 conductor shielded, Belden 9843, 9841 or comparable.
2. DC Power: 18 AWG, 2 conductor, Belden 8760 or comparable.
3. Provide type of data and DC power cabling required by access control device manufacturer for this installation.
4. Where scheduled in the hardware sets, provide each item of electrified hardware and wire harnesses with sufficient number and wire gauge with standardized Molex plug connectors to accommodate electric function of specified hardware. Provide Molex connectors that plug directly into connectors from harnesses, electric locking and power transfer devices. Provide through-door wire harness for each electrified locking device installed in a door and wire harness for each electrified hinge, electrified continuous hinge, electrified pivot, and electric power transfer for connection to power supplies.

2.3 HINGES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product: Ives 5BB series.

B. Requirements:

1. Provide hinges conforming to ANSI/BHMA A156.1.
2. 1-3/4 inch thick doors, up to and including 36 inches wide:

   a. Exterior: Standard weight, bronze or stainless steel, 4-1/2 inches high
   b. Interior: Standard weight, steel, 4-1/2 inches high

3. 1-3/4 inch thick doors over 36 inches wide:

   a. Exterior: Heavy weight, bronze/stainless steel, 5 inches high
   b. Interior: Heavy weight, steel, 5 inches high

4. 2 inches or thicker doors:

a. Exterior: Heavy weight, bronze or stainless steel, 5 inches high
b. Interior: Heavy weight, steel, 5 inches high

5. Provide three hinges per door leaf for doors 90 inches or less in height, and one additional hinge for each 30 inches of additional door height.
6. Where new hinges are specified for existing doors or existing frames, provide new hinges of identical size to hinge preparation present in existing door or existing frame.
7. Hinge Pins: Except as otherwise indicated, provide hinge pins as follows:

a. Steel Hinges: Steel pins
b. Non-Ferrous Hinges: Stainless steel pins
c. Out-Swinging Exterior Doors: Non-removable pins
d. Out-Swinging Interior Lockable Doors: Non-removable pins
e. Interior Non-lockable Doors: Non-rising pins

8. Width of hinges: 4-1/2 inches at 1-3/4 inch thick doors, and 5 inches at 2 inches or thicker doors. Adjust hinge width as required for door, frame, and wall conditions to allow proper degree of opening.

2.4 CONTINUOUS HINGES

A. Aluminum Geared

1. Manufacturers:

a. Scheduled Manufacturer: Ives.

2. Requirements:

a. Provide aluminum geared continuous hinges conforming to ANSI/BHMA A156.26, Grade 1.
b. Provide aluminum geared continuous hinges, where specified in the hardware sets, fabricated from 6063-T6 aluminum.
c. Provide split nylon bearings at each hinge knuckle for quiet, smooth, self-lubricating operation.
d. Provide hinges capable of supporting door weights up to 450 pounds, and successfully tested for 1,500,000 cycles.
e. On fire-rated doors, provide aluminum geared continuous hinges that are classified for use on rated doors by testing agency acceptable to authority having jurisdiction.
f. Provide aluminum geared continuous hinges with electrified option scheduled in the hardware sets. Provide with sufficient number and wire gage to accommodate electric function of specified hardware.
g. Install hinges with fasteners supplied by manufacturer.
h. Provide hinges 1 inch shorter in length than nominal height of door, unless otherwise noted or door details require shorter length and with symmetrical hole pattern.

2.5 ELECTRIC POWER TRANSFER

A. Manufacturers:

a. Scheduled Manufacturer: Von Duprin EPT-10.

B. Provide power transfer with electrified options as scheduled in the hardware sets. Provide with number and gage of wires sufficient to accommodate electric function of specified hardware.

C. Locate electric power transfer per manufacturer's template and UL requirements, unless interference with operation of door or other hardware items.

2.6 MORTISE LOCKS

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product: Schlage L9000 series.
2. Acceptable Manufacturers and Products: No substitution.

B. Requirements:

1. Provide mortise locks conforming to ANSI/BHMA A156.13 Series 1000, Grade 1, and UL Listed for 3 hour fire doors.
2. Indicators: Where specified, provide indicator window measuring a minimum 2 inch x 1/2 inch with 180 degree visibility. Provide messages color-coded with full text and/or symbols, as scheduled, for easy visibility.

   a. Outside Occupancy Indicator: Provide indicator above cylinder or emergency release for visibility while operating the lock that identifies an occupied/unoccupied status of the lock or latch.

3. Provide locks manufactured from heavy gauge steel, containing components of steel with a zinc dichromate plating for corrosion resistance.
4. Provide lock case that is multi-function and field reversible for handing without opening case. Cylinders: Refer to "KEYING" article, herein.
5. Provide locks with standard 2-3/4 inches backset with full 3/4 inch throw stainless steel mechanical anti-friction latchbolt. Provide deadbolt with full 1 inch throw, constructed of stainless steel.
6. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim.
7. Provide electrified options as scheduled in the hardware sets. Where scheduled, provide switches and sensors integrated into the locks and latches.
8. Provide motor based electrified locksets with electrified options as scheduled in the hardware sets and comply with the following requirements:

   a. Universal input voltage – single chassis accepts 12 or 24V DC to allow for changes in the field without changing lock chassis.
   b. Fail Safe/Fail Secure – changing mode between electrically locked (fail safe) and electrically unlocked (fail secure) is field selectable without opening the lock case
   c. Low maximum current draw – maximum 0.4 amps to allow for multiple locks on a single power supply.
   d. Low holding current – maximum 0.01 amps to produce minimal heat, eliminate "hot

levers" in electrically locked applications, and to provide reliable operation in wood doors that provide minimal ventilation and air flow.

e. Request to Exit Switch (RX) –

1) Modular Design – provide electrified locks capable of using, adding, or changing a modular RX switch without opening the lock case.
2) Monitoring – where scheduled, provide a request to exit (RX) switch that detects rotation of the inside lever.

f. Connections – provide quick-connect Molex system standard.

9. Lever Trim: Solid brass, bronze, or stainless steel, cast or forged in design specified, with wrought roses and external lever spring cages. Provide thru-bolted levers with 2-piece spindles.

a. Lever Design: Schlage 03N

2.7 EXIT DEVICES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product: Von Duprin 99 series – No substitutions.

B. Requirements:

1. Provide exit devices tested to ANSI/BHMA A156.3 Grade 1 and UL listed for Panic Exit or Fire Exit Hardware.
2. Cylinders: Refer to "KEYING" article, herein.
3. Provide touchpad type exit devices, fabricated of brass, bronze, stainless steel, or aluminum, plated to standard architectural finishes to match balance of door hardware.
4. Touchpad must extend a minimum of one half of door width. No plastic inserts are allowed in touchpads.
5. Provide exit devices with deadlatching feature for security and for future addition of alarm kits and/or other electrified requirements.
6. Provide flush end caps for exit devices.
7. Provide exit devices with manufacturer's approved strikes.
8. Provide exit devices cut to door width and height. Install exit devices at height recommended by exit device manufacturer, allowable by governing building codes, and approved by Architect.
9. Mount mechanism case flush on face of doors or provide spacers to fill gaps behind devices. Where glass trim or molding projects off face of door, provide glass bead kits.
10. Provide cylindrical or hex-key dogging as specified at non fire-rated openings.
11. Provide dogging indicators (CDSI) for visible indication of dogging status.
12. Removable Mullions: 2 inches x 3 inches steel tube. Where scheduled as keyed removable mullion, provide type that can be removed by use of a keyed cylinder, which is self-locking when re-installed.
13. Provide factory drilled weep holes for exit devices used in full exterior application, highly corrosive areas, and where noted in hardware sets.
14. Provide electrified options as scheduled.

15. Top latch mounting: double or single tab mount for steel doors, face mount for aluminum doors eliminating requirement of tabs, and double tab mount for wood doors.
16. Provide exit devices with optional trim designs to match other lever and pull designs used on the project.

    a. Tactile Warning (Knurling): Where required by authority having jurisdiction. Provide on levers on exterior (secure side) of doors serving rooms considered to be hazardous.

2.8 CYLINDERS

A. Manufacturers:

1. Scheduled Manufacturer: Falcon – No substitutions.

B. Requirements:

1. Provide cylinders/cores, compliant with ANSI/BHMA A156.5; latest revision; cylinder face finished to match lockset, manufacturer's series as indicated. Refer to "KEYING" article, herein.
2. Provide cylinders in the below-listed configuration(s), distributed throughout the Project as indicated.

    a. Conventional Open: cylinder with small format interchangeable core (SFIC) core with open "K" keyway

3. Replaceable Construction Cores.

    a. Provide temporary construction cores replaceable by permanent cores, furnished in accordance with the following requirements.

        1) 3 construction control keys
        2) 12 construction change (day) keys.

    b. Owner or Owner's Representative will replace temporary construction cores with permanent cores.

2.9 KEYING

A. Provide a factory registered keying system, complying with guidelines in ANSI/BHMA A156.28, incorporating decisions made at keying conference.

B. Provide cylinders/cores keyed into Owner's existing factory registered keying system.

C. Comply with guidelines in ANSI/BHMA A156.28, incorporating decisions made at keying conference.

D. CONTRACTOR will install permanent cylinders/cores.

E. Locksets and cores: keyed at factory of lock manufacturer where permanent records are maintained.

F. Furnish 1 additional key blank for each lock on the project. Provide for a minimum of 100 blanks on each new construction project.

G. Provide 20 uncombinated cores per project matching the finish and keyway of the project.

H. Furnish temporary construction cores at all Construction phase trims to receive future Access Control Trims and Cylinders specified for Card Key Access Doors. Construction phase trims remain OWNER'S property.

I. Requirements:

1. Provide permanent cylinders/cores keyed by the manufacturer according to the following key system.

    a. Master Keying system as directed by the Owner.

2. Forward bitting list and keys separately from cylinders, by means as directed by Owner. Failure to comply with forwarding requirements will be cause for replacement of cylinders/cores involved at no additional cost to Owner.
3. Provide keys with the following features:

    a. Material: Nickel silver; minimum thickness of .107-inch (2.3mm)
    b. Patent Protection: Keys and blanks protected by one or more utility patent(s)

4. Identification:

    a. Mark permanent cylinders/cores and keys with applicable blind code per DHI publication "Keying Systems and Nomenclature" for identification. Do not provide blind code marks with actual key cuts.
    b. Identification stamping provisions must be approved by the Architect and Owner.
    c. Stamp cylinders/cores and keys with Owner's unique key system facility code as established by the manufacturer; key symbol and embossed or stamped with "DO NOT DUPLICATE" along with the "PATENTED" or patent number to enforce the patent protection.
    d. Failure to comply with stamping requirements will be cause for replacement of keys involved at no additional cost to Owner.
    e. Forward permanent cylinders/cores to Owner, separately from keys, by means as directed by Owner.

5. Quantity: Furnish in the following quantities.

    a. Change (Day) Keys: 3 per cylinder/core.
    b. Permanent Control Keys: 3.
    c. Master Keys: 6

2.10 KEY CONTROL SYSTEM

A. Requirements:

1. The local hardware supplier will provide a printed index listing as follow:

   a. Key tag # x room graphics x key change # x key set symbol x foot note remarks.

2. Furnish deluxe 2 tag wall mounted key cabinet complete for each new facility have a capacity to match the quantity of door locks for the project plus 150% (one hundred and fifty percent) expansion.
3. The general CONTRACTOR shall install the key cabinet(s) with spare keys as director by the OWNER.

2.11 DOOR CLOSERS

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product: LCN 4040XP series.
2. Acceptable Manufacturers & Products: No substitution.

B. Requirements:

1. Provide door closers conforming to ANSI/BHMA A156.4 Grade 1 requirements by BHMA certified independent testing laboratory. ISO 9000 certify closers. Stamp units with date of manufacture code.
2. Provide door closers with fully hydraulic, full rack and pinion action with high strength cast iron cylinder, and full complement bearings at shaft.
3. Cylinder Body: 1-1/2 inch diameter with 3/4 inch diameter double heat-treated pinion journal.
4. Hydraulic Fluid: Fireproof, passing requirements of UL10C, and requiring no seasonal closer adjustment for temperatures ranging from 120 degrees F to -30 degrees F.
5. Spring Power: Continuously adjustable over full range of closer sizes, and providing reduced opening force as required by accessibility codes and standards.
6. Hydraulic Regulation: By tamper-proof, non-critical valves, with separate adjustment for latch speed, general speed, and backcheck.
7. Provide closers with solid forged steel main arms and factory assembled heavy-duty forged forearms for parallel arm closers.
8. Pressure Relief Valve (PRV) Technology: Not permitted.
9. Finish for Closer Cylinders, Arms, Adapter Plates, and Metal Covers: Powder coating finish which has been certified to exceed 100 hours salt spray testing as described in ANSI Standard A156.4 and ASTM B117, or has special rust inhibitor (SRI).
10. Provide special templates, drop plates, mounting brackets, or adapters for arms as required for details, overhead stops, and other door hardware items interfering with closer mounting.

2.12 DOOR TRIM

A. Manufacturers:

1. Scheduled Manufacturer: Ives.

B. Requirements:

1. Provide push plates 4 inches wide by 16 inches high by 0.050 inch thick and beveled 4 edges. Where width of door stile prevents use of 4 inches wide plate, adjust width to fit.
2. Provide push bars of solid bar stock, diameter and length as scheduled. Provide push bars of sufficient length to span from center to center of each stile. Where required, mount back to back with pull.
3. Provide offset pulls of solid bar stock, diameter and length as scheduled. Where required, mount back to back with push bar.
4. Provide flush pulls as scheduled. Where required, provide back-to-back mounted model.
5. Provide pulls of solid bar stock, diameter and length as scheduled. Where required, mount back to back with push bar.
6. Provide pull plates 4 inches wide by 16 inches high by 0.050 inch thick, beveled 4 edges, and prepped for pull. Where width of door stile prevents use of 4 inches wide plate, adjust width to fit.
7. Provide wire pulls of solid bar stock, diameter and length as scheduled.
8. Provide decorative pulls as scheduled. Where required, mount back to back with pull.

2.13 PROTECTION PLATES

A. Manufacturers:

1. Scheduled Manufacturer: Ives.

B. Requirements:

1. Provide kick plates, mop plates, and armor plates minimum of 0.050 inch thick, beveled four edges as scheduled. Furnish with sheet metal or wood screws, finished to match plates.
2. Sizes of plates:

    a. Kick Plates: 10 inches high by 2 inches less width of door on single doors, 1 inch less width of door on pairs
    b. Mop Plates: 4 inches high by 2 inches less width of door on single doors, 1 inch less width of door on pairs
    c. Armor Plates: 36 inches high by 2 inches less width of door on single doors, 1 inch less width of door on pairs.

2.14 DOOR STOPS AND HOLDERS

A. Manufacturers:

1. Scheduled Manufacturer: Ives.

B. Provide door stops at each door leaf:

1. Provide wall stops wherever possible. Provide convex type where mortise type locks are used and concave type where cylindrical type locks are used.
2. Where a wall stop cannot be used, provide universal floor stops for low or high rise options.

3. Where wall or floor stop cannot be used, provide medium duty surface mounted overhead stop.

2.15 OVERHEAD STOPS AND OVERHEAD STOP/HOLDERS

A. Manufacturers:

1. Scheduled Manufacturers: Glynn-Johnson.

B. Requirements:

1. Provide heavy duty concealed mounted overhead stop or holder as specified for exterior and interior vestibule single acting doors.
2. Provide heavy duty concealed mounted overhead stop or holder as specified for double acting doors.
3. Provide heavy or medium duty and concealed or surface mounted overhead stop or holder for interior doors as specified. Provide medium duty surface mounted overhead stop for interior doors and at any door that swings more than 140 degrees before striking wall, open against equipment, casework, sidelights, and where conditions do not allow wall stop or floor stop presents tripping hazard.
4. Where overhead holders are specified provide friction type at doors without closer and positive type at doors with closer.

2.16 THRESHOLDS, SEALS, DOOR SWEEPS, AUTOMATIC DOOR BOTTOMS, AND GASKETING

A. Manufacturers:

1. Scheduled Manufacturer: Zero International.

B. Requirements:

1. Provide thresholds, weather-stripping (including door sweeps, seals, and astragals) and gasketing systems (including smoke, sound, and light) as specified and per architectural details. Match finish of other items.
2. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that meets requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105.
3. Size of thresholds:

   a. Saddle Thresholds: 1/2 inch high by jamb width by door width
   b. Bumper Seal Thresholds: 1/2 inch high by 5 inches wide by door width

4. Provide door sweeps, seals, astragals, and auto door bottoms only of type where resilient or flexible seal strip is easily replaceable and readily available.

2.17 SILENCERS

A. Manufacturers:

1. Scheduled Manufacturer: Ives.

B. Requirements:

1. Provide "push-in" type silencers for hollow metal or wood frames.
2. Provide one silencer per 30 inches of height on each single frame, and two for each pair frame.
3. Omit where gasketing is specified.

2.18 FINISHES

A. Finish: BHMA 626/652 (US26D); except:

1. Hinges at Exterior Doors: BHMA 630 (US32D)
2. Continuous Hinges: BHMA 630 (US32D)
3. Continuous Hinges: BHMA 628 (US28)
4. Push Plates, Pulls, and Push Bars: BHMA 630 (US32D)
5. Protection Plates: BHMA 630 (US32D)
6. Overhead Stops and Holders: BHMA 630 (US32D)
7. Door Closers: Powder Coat to Match
8. Wall Stops: BHMA 630 (US32D)
9. Latch Protectors: BHMA 630 (US32D)
10. Weatherstripping: Clear Anodized Aluminum
11. Thresholds: Mill Finish Aluminum

PART 3 - EXECUTION

3.1 EXAMINATION

A. Prior to installation of hardware, examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance.

B. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Mount door hardware units at heights to comply with the following, unless otherwise indicated or required to comply with governing regulations.

1. Standard Steel Doors and Frames: ANSI/SDI A250.8.

2. Custom Steel Doors and Frames: HMMA 831.
3. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."

B. Install each hardware item in compliance with manufacturer's instructions and recommendations, using only fasteners provided by manufacturer.

C. Do not install surface mounted items until finishes have been completed on substrate. Protect all installed hardware during painting.

D. Set units level, plumb and true to line and location. Adjust and reinforce attachment substrate as necessary for proper installation and operation.

E. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.

F. Install operating parts so they move freely and smoothly without binding, sticking, or excessive clearance.

G. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than quantity recommended by manufacturer for application indicated or one hinge for every 30 inches of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.

H. Lock Cylinders: Install construction cores to secure building and areas during construction period.

1. Replace construction cores with permanent cores as indicated in keying section.

I. Wiring: Coordinate with Division 26, ELECTRICAL sections for:

1. Conduit, junction boxes and wire pulls.
2. Connections to and from power supplies to electrified hardware.
3. Connections to fire/smoke alarm system and smoke evacuation system.
4. Connection of wire to door position switches and wire runs to central room or area, as directed by Architect.
5. Testing and labeling wires with Architect's opening number.

J. Key Control System: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.

K. Door Closers: Mount closers on room side of corridor doors, inside of exterior doors, and stair side of stairway doors from corridors. Mount closers so they are not visible in corridors, lobbies and other public spaces unless approved by Architect.

L. Closer/Holders: Mount closer/holders on room side of corridor doors, inside of exterior doors, and stair side of stairway doors.

M. Power Supplies: Locate power supplies as indicated or, if not indicated, above accessible ceilings or in equipment room, or alternate location as directed by Architect.

N. Thresholds: Set thresholds in full bed of sealant complying with requirements specified in Division 07 Section "Joint Sealants."

O. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they may impede traffic or present tripping hazard.

P. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.

Q. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.

R. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

3.3 FIELD QUALITY CONTROL

A. Engage qualified manufacturer trained representative to perform inspections and to prepare inspection reports.

1. Representative will inspect door hardware and state in each report whether installed work complies with or deviates from requirements, including whether door hardware is properly installed and adjusted.

3.4 ADJUSTING

A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

1. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.

B. Occupancy Adjustment: Approximately three to six months after date of Substantial Completion, Installer's Architectural Hardware Consultant must examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors and door hardware.

3.5 CLEANING AND PROTECTION

A. Clean adjacent surfaces soiled by door hardware installation.

B. Clean operating items as necessary to restore proper function and finish.

C. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of Substantial Completion.

3.6 DOOR HARDWARE SCHEDULE

A. Hardware items are referenced in the following hardware. Refer to the above-specifications for special features, options, cylinders/keying, and other requirements.

B. Hardware Sets:

OPT0398776 Version 1
Hardware Group No. 001
PROVIDE EACH RU DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	SFIC MORTISE CYLINDER	C987 X CAM & COLLAR AS REQ	626	FAL
1	EA	SFIC CORE	C607	626	FAL
1	EA	SFIC CONST. CORE	C607CCA	622	FAL

NOTE: ALL HARDWARE BY DOOR MFR. COORDINATE KEYING REQUIREMENTS.

Hardware Group No. 002
PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	SFIC MORTISE CYLINDER	C987 X CAM & COLLAR AS REQ	626	FAL
1	EA	SFIC CORE	C607	626	FAL

PROVIDE AT NEW ACCESS DOORS. CONFIRM QUANTITY WITH DESIGN TEAM.

Hardware Group No. 203
PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	STOREROOM LOCK	L9080HD 03N	626	SCH
1	EA	SFIC CORE	C607	626	FAL
1	EA	WALL STOP	WS406/407CCV	626	IVE
1	EA	GASKETING	488S PSA H & J (USE SILENCERS @ NON-RATED DOORS)	BK	ZER

Hardware Group No. 203W
PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 5 X 4.5	652	IVE
1	EA	STOREROOM LOCK	L9080HD 03N	626	SCH
1	EA	SFIC CORE	C607	626	FAL
1	EA	WALL STOP	WS406/407CCV	626	IVE
1	EA	GASKETING	488S PSA H & J (USE SILENCERS @ NON-RATED DOORS)	BK	ZER

Hardware Group No. 738MR
PROVIDE EACH PR DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
6	EA	HINGE	5BB1HW 4.5 X 4.5	652	IVE

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	FIRE RATED REMOVABLE MULLION	KR9954 STAB MT54 HEIGHT AS REQ	689	VON
2	EA	FIRE EXIT HARDWARE	99-L-BE-F-03-SNB LENGTH AS REQ	626	VON
1	EA	SFIC MORTISE CYLINDER	C987 X CAM & COLLAR AS REQ	626	FAL
1	EA	SFIC CORE	C607	626	FAL
2	EA	SURFACE CLOSER	4040XP REG/PA X MTG BRKT, SPCR & PLATE AS REQ	689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS AS REQ	630	IVE
2	EA	FIRE/LIFE WALL MAG	SEM7800 SERIES AS REQUIRED	689	LCN
1	SET	MEETING STILE	328AA (2 PCS - 1 SET)	AA	ZER
1	EA	GASKETING	488SBK PSA H & J	BK	ZER
1	EA	MULLION SEAL	8780NBK PSA	BK	ZER

-PROVIDE 120VAC AND FIRE ALARM CONNECTIONS FOR WALL MAGNETIC HOLD OPENS.
-WIRE THE MAGNETIC HOLD OPENS TO THE FIRE ALARM SYSTEM.
-THE MAGNETIC HOLD OPENS ARE TO RELEASE UPON ACTIVATION OF THE FIRE ALARMS SYSTEM.

Hardware Group No. 750CM
PROVIDE EACH PR DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
6	EA	HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	REMOVABLE MULLION	KR4954 STAB MT54 HEIGHT AS REQ	689	VON
2	EA	PANIC HARDWARE	CDSI-99-L-03 LENGTH AS REQ	626	VON
2	EA	SFIC RIM CYLINDER	C953-7CCA	626	FAL
3	EA	SFIC MORTISE CYLINDER	C987 X CAM & COLLAR AS REQ	626	FAL
5	EA	SFIC CORE	C607	626	FAL
2	EA	SURFACE CLOSER	4040XP SCUSH X MTG BRKT, SPCR & PLATE AS REQ	689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS AS REQ	630	IVE
4	EA	SILENCER	SR64	GRY	IVE

Hardware Group No. 801L
PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	CLASSROOM DEAD LOCK	L463HD	626	SCH
1	EA	SFIC CORE	C607	626	FAL
1	EA	PUSH PLATE	8200 4" X 16"	630	IVE
1	EA	PULL PLATE	8303EZHD 10" 4" X 16"	630	IVE
1	EA	SURFACE CLOSER	4040XP REG/PA X MTG BRKT, SPCR & PLATE AS REQ	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS AS REQ	630	IVE
1	EA	WALL STOP	WS406/407CCV	626	IVE
4	EA	SILENCER	SR64	GRY	IVE

Hardware Group No. C201C

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	POWER TRANSFER	EPT10 CON	689	VON
1	EA	ELEC CLASSROOM LOCK	AD-300-MS-70-MT-TLR-B (BY SECURITY CONTRACTOR)	626	SCE
1	EA	SFIC CORE	C607	626	FAL
1	EA	SFIC CONST. CORE	C607CCA	622	FAL
1	EA	SURFACE CLOSER	4040XP SCUSH X MTG BRKT, SPCR & PLATE AS REQ	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS AS REQ	630	IVE
1	EA	GASKETING	488S PSA H & J (USE SILENCERS @ NON-RATED DOORS)	BK	ZER
1	EA	HARNESS (IN DOOR)	ALLEGION CONNECT TYPE & LENGTH AS REQ		SCH
1	EA	HARNESS (TO POWER SUPPLY)	CON-6W (CONNECTION LEADS)		SCH
1		POWER SUPPLY	BY SECURITY CONTRACTOR		

OPERATIONAL DESCRIPTION: DOOR NORMALLY CLOSED AND LOCKED. ENTRY BY VALID CARD READ OR MANUAL KEY OVERRIDE. FREE EGRESS AT ALL TIME. UPON LOSS OF POWER, DOOR TO REMAIN LOCKED.

Hardware Group No. C714AM
PROVIDE EACH PR DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CONT. HINGE	112XY HEIGHT AS REQ	628	IVE
1	EA	CONT. HINGE	112XY EPT HEIGHT AS REQ	628	IVE
1	EA	POWER TRANSFER	EPT10 CON	689	VON
1	EA	REMOVABLE MULLION	KR4954 STAB MT54 HEIGHT AS REQ	689	VON
2	EA	PANIC HARDWARE	LD-99-EO-SNB LENGTH AS REQ	626	VON
1	EA	ELEC EXIT DEVICE TRIM	AD-300-993R-70-MT-TLR-B (BY SECURITY CONTRACTOR)	626	SCE
1	EA	SFIC MORTISE CYLINDER	C987 X CAM & COLLAR AS REQ	626	FAL
2	EA	SFIC CORE	C607	626	FAL
1	EA	SFIC CONST. CORE	C607CCA	622	FAL
1	EA	DOOR PULL	VR910 DT (INACTIVE LEAF)	630	IVE
2	EA	SURFACE CLOSER	4040XP SCUSH X MTG BRKT, SPCR & PLATE AS REQ	689	LCN
2	EA	MULLION SEAL	8780NBK PSA	BK	ZER
1	EA	SEALS	BY DOOR/ FRAME MANUF.		B/O
2	EA	DOOR SWEEP	39A LENGTH AS REQ	AA	ZER
1	EA	THRESHOLD	655A LENGTH AS REQ	A	ZER
1	EA	HARNESS (IN DOOR)	ALLEGION CONNECT TYPE & LENGTH AS REQ		SCH
1	EA	HARNESS (TO POWER SUPPLY)	CON-6W (CONNECTION LEADS)		SCH
1		RX SWITCH	BY SECURITY CONTRACTOR		

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1		POWER SUPPLY	BY SECURITY CONTRACTOR		

OPERATIONAL DESCRIPTION: DOORS NORMALLY CLOSED AND LOCKED. ENTRY BY VALID CARD READ OR MANUAL KEY OVERRIDE. FREE EGRESS AT ALL TIME. UPON LOSS OF POWER, DOORS TO REMAIN LOCKED.

Hardware Group No. D724M
PROVIDE EACH PR DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
2	EA	CONT. HINGE	112XY HEIGHT AS REQ	628	IVE
1	EA	REMOVABLE MULLION	KR4954 STAB MT54 HEIGHT AS REQ	695	VON
2	EA	PANIC HARDWARE	LD-99-EO-SNB LENGTH AS REQ	626	VON
1	EA	SFIC RIM CYLINDER	C953-7CCA	626	FAL
1	EA	SFIC MORTISE CYLINDER	C987 X CAM & COLLAR AS REQ	626	FAL
2	EA	SFIC CORE	C607	626	FAL
2	EA	SURFACE CLOSER	4040XP SCUSH X MTG BRKT, SPCR & PLATE AS REQ	689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS AS REQ	630	IVE
1	SET	GASKETING	328AA H & J	AA	ZER
1	EA	MULLION SEAL	8780NBK PSA	BK	ZER
2	EA	DOOR SWEEP	39A LENGTH AS REQ	AA	ZER
1	EA	THRESHOLD	655A LENGTH AS REQ	A	ZER
2		DOOR CONTACT	BY SECURITY CONTRACTOR		

EXIT ONLY. KEYED ENTRY ONLY - NO TRIM.

END OF SECTION 087100

SECTION 088000 - GLAZING

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. Glass for windows, doors, and storefront framing,.
2. Glazing sealants and accessories.

B. Related Requirements:

1. Section 088813 "Fire-Resistant Glazing."

1.3 DEFINITIONS

A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.

B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C1036.

C. IBC: International Building Code.

D. Interspace: Space between lites of an insulating-glass unit.

1.4 COORDINATION

A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Glass Sampl**es**: For each type of the following products; 12 inches square.

1. Coated glass.
2. Insulating glass.

C. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and manufacturers of insulating-glass units with sputter-coated, low-E coatings.

B. Sample Warranties: For special warranties.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications for Insulating-Glass Units with Sputter-Coated, Low-E Coatings: A qualified insulating-glass manufacturer who is approved by coated-glass manufacturer.

B. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

B. Comply with insulating-glass manufacturer's written instructions for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

1.9 FIELD CONDITIONS

A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.

1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or are below 40 deg F.

1.10 WARRANTY

A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.

1. Warranty Period: 10 years from date of Substantial Completion.

B. Manufacturer's Special Warranty for Insulating Laminated Glass: Manufacturer agrees to replace insulating laminated-glass units that deteriorate within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Refer to “Glass Types” Articles in this Section for manufacturers.

B. Source Limitations for Glass: Obtain from single source from single manufacturer for each glass type.

C. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer for each product and installation method.

2.2 PERFORMANCE REQUIREMENTS

A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

B. Structural Performance: Glazing shall withstand the following design loads within limits and under conditions indicated determined according to the IBC and ASTM E1300.

1. Design Wind Pressures: As indicated on Structural Drawings.
2. Design Wind Pressures: Determine design wind pressures applicable to Project according to ASCE/SEI 7, based on heights above grade indicated on Drawings.

a. Wind Design Data: As indicated on Structural Drawings.

3. Design Snow Loads: As indicated on Drawings.

4. Maximum Lateral Deflection: For glass supported on all four edges, limit center-of-glass deflection at design wind pressure to not more than 1/50 times the short-side length or 1 inch, whichever is less.
5. Differential Shading: Design glass to resist thermal stresses induced by differential shading within individual glass lites.

C. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.

D. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:

1. For monolithic-glass lites, properties are based on units with lites 6 mm thick.
2. For laminated-glass lites, properties are based on products of construction indicated.
3. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.
4. U-Factors: Center-of-glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as Btu/sq. ft. x h x deg F.
5. Solar Heat-Gain Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.
6. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

2.3 GLASS PRODUCTS, GENERAL

A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.

1. GANA Publications: "Glazing Manual."
2. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."

B. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the SGCC or manufacturer. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.

C. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.

D. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass that complies with performance requirements and is not less than the thickness indicated.

1. Minimum Glass Thickness for Exterior Lites: 6 mm.
2. Thickness of Tinted Glass: Provide same thickness for each tint color indicated throughout Project.

E. Strength: Where fully tempered float glass is indicated, provide fully tempered float glass.

2.4 GLASS PRODUCTS

A. Clear Annealed Float Glass: ASTM C1036, Type I, Class 1 (clear), Quality-Q3.

B. Tinted Annealed Float Glass: ASTM C1036, Type I, Class 2 (tinted), Quality-Q3.

C. Fully Tempered Float Glass: ASTM C1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.

1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.

D. Heat-Strengthened Float Glass: ASTM C1048, Kind HS (heat strengthened), Type I, Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.

1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.

2.5 LAMINATED GLASS

A. Laminated Glass: ASTM C1172. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.

1. Construction: Laminate glass with polyvinyl butyral interlayer to comply with interlayer manufacturer's written instructions.
2. Interlayer Thickness: Provide thickness not less than that indicated and as needed to comply with requirements.
3. Interlayer Color: Clear unless otherwise indicated.

2.6 INSULATING GLASS

A. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E2190.

1. Sealing System: Dual seal, with polyisobutylene and silicone primary and secondary sealants.
2. Perimeter Warm Edge Spacer: Stainless steel.
3. Desiccant: Molecular sieve or silica gel, or a blend of both.

2.7 GLAZING SEALANTS

A. General:

1. Compatibility: Compatible with one another and with other materials they contact, including glass products, seals of insulating-glass units, and glazing channel substrates,

under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.

2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
3. Verify sealant has a VOC content of 250 g/L or less.
4. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range.

B. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C920, Type S, Grade NS, Class 100/50, Use NT.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Dow Corning Corporation; Dow Corning® 790 Silicone Building Sealant.
b. GE Construction Sealants; Momentive Performance Materials Inc.; SCS2700 SilPruf LM.
c. May National Associates, Inc.; a subsidiary of Sika Corporation; Bondaflex Sil 290.
d. Pecora Corporation; 890NST.
e. Sika Corporation; SikaSil WS-290.
f. Tremco Incorporated; Spectrem 1.

2.8 GLAZING TAPES

A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C1281 and AAMA 800 for products indicated below:

1. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
2. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:

1. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.
2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.9 MISCELLANEOUS GLAZING MATERIALS

A. General: Provide products of material, size, and shape complying with referenced glazing standard, with requirements of manufacturers of glass and other glazing materials for

application indicated, and with a proven record of compatibility with surfaces contacted in installation.

B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

C. Setting Blocks:

1. Elastomeric material with a Shore A durometer hardness of 85, plus or minus 5.
2. Type recommended by sealant or glass manufacturer.

D. Spacers:

1. Elastomeric material blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
2. Type recommended by sealant or glass manufacturer.

E. Edge Blocks:

1. Elastomeric material with a Shore A durometer hardness per manufacturer's written instructions.
2. Type recommended by sealant or glass manufacturer.

F. Cylindrical Glazing Sealant Backing: ASTM C1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

2.10 FABRICATION OF GLAZING UNITS

A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.

1. Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.

a. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

B. Grind smooth and polish exposed glass edges and corners.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:

1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
2. Presence and functioning of weep systems.
3. Minimum required face and edge clearances.
4. Effective sealing between joints of glass-framing members.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that leave visible marks in the completed Work.

3.3 GLAZING, GENERAL

A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.

B. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass includes glass with edge damage or other imperfections that, when installed, could weaken glass, impair performance, or impair appearance.

C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.

D. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

F. Provide spacers for glass lites where length plus width is larger than 50 inches.

1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
2. Provide 1/8-inch minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.

G. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

H. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

I. Set glass lites with proper orientation so that coatings face exterior or interior as specified.

J. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.

K. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

3.4 TAPE GLAZING

A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.

B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.

C. Cover vertical framing joints by applying tapes to heads and sills first, then to jambs. Cover horizontal framing joints by applying tapes to jambs, then to heads and sills.

D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.

E. Do not remove release paper from tape until right before each glazing unit is installed.

F. Apply heel bead of elastomeric sealant.

G. Center glass lites in openings on setting blocks, and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.

H. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.5 GASKET GLAZING (DRY)

A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.

B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.

C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

E. Install gaskets so they protrude past face of glazing stops.

3.6 SEALANT GLAZING (WET)

A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.

B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.

C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.7 CLEANING AND PROTECTION

A. Immediately after installation remove nonpermanent labels and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains.

1. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without damage to coatings.

C. Remove and replace glass that is damaged during construction period.

3.8 MONOLITHIC GLASS SCHEDULE

A. Glass Type CTG: Clear fully tempered float glass.

1. Minimum Thickness: 6 mm.
2. Safety glazing required.

3.9 INSULATING-LAMINATED-GLASS SCHEDULE

A. Glass Type TTLIG: Low-E-coated, tinted, tempered, laminated insulating glass.

1. Basis-of-Design Product: Vitro Architectural Glass; Solarban 70 (2) Optigray + Clear + Clear.

    a. Other Approved Coated Products:

        1) AGC Glass Company North America; Energy Select 25 Pure Grey (2).
        2) Guardian: SuperNeutral 54 (32) Crystal Gray (out).

2. Overall Unit Thickness: 1 1/8 inch (28.6 mm).
3. Minimum Thickness of Outdoor Lite: 6 mm.
4. Outdoor Lite: Tinted fully tempered float glass.
5. Tint Color: As indicated by manufacturer’s product designations above.
6. Interspace Content: Air.
7. Spacer: Warm edge.
8. Indoor Lite: Clear laminated glass with two plies of fully tempered float glass.

    a. Minimum Thickness of Each Glass Ply: 5 mm.
    b. Interlayer Thickness: 0.060 inch.
    c. Interlayer Color: Clear.

9. Low-E Coating: Sputtered on second surface.
10. Winter Nighttime U-Factor: 0.28 maximum.
11. Summer Daytime U-Factor: 0.26 maximum.
12. Visible Light Transmittance: 45 percent minimum.
13. Total Solar Transmittance: 16 percent maximum.
14. Exterior Solar Reflectance: 18 percent.
15. Exterior Visible Reflectance: 9 percent.
16. Interior Visible Reflectance: 13 percent.
17. Shading Coefficient: 0.26 maximum.
18. Solar Heat Gain Coefficient: 0.22 maximum.
19. Safety glazing required.

END OF SECTION 088000

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SECTION 088813 - FIRE-RATED GLAZING

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. Fire-protection-rated glazing (FPGL).

1.3 DEFINITIONS

A. Fire-Protection-Rated Glazing: Glazing in rated doors and openings up to 45 minutes, limited in size, and not capable of blocking radiant heat.

B. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.

C. Glass Thicknesses: Indicated by thickness designations in millimeters in accordance with ASTM C1036.

1.4 COORDINATION

A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Certificates: For each type of glass and glazing product.

C. Sample Warranties: For special warranties.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect glazing materials in accordance with manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install fire-resistant glazing until spaces are enclosed and weathertight and temporary HVAC system is operating and maintaining ambient temperature conditions at occupancy levels during remainder of construction period.

1.9 WARRANTY

A. Manufacturer's Special Warranty for Fire-Protection Rated Glass: Manufacturer agrees to replace glass units that deteriorate within specified warranty period. Deterioration of glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning glass contrary to manufacturer's written instructions. .

1. Warranty Period: Three years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations for Glass: For each glass type, obtain from single source from single manufacturer.

B. Source Limitations for Glazing Accessories: For each product and installation method, obtain from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. General: Installed glazing systems shall withstand normal thermal movement and impact loads (where applicable) without failure, including loss or glass breakage attributable to defective manufacture, fabrication, or installation; deterioration of glazing materials; or other defects in construction.

2.3 GLASS PRODUCTS, GENERAL

A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organization below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.

1. NGA Publications: "Laminated Glazing Reference Manual" and "Glazing Manual."

B. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the SGCC or manufacturer. Label shall indicate manufacturer's name, type of glass, glass thickness, and safety glazing standard with which glass complies.

2.4 GLASS PRODUCTS

A. Float Glass: ASTM C1036, Type I, Quality-Q3, Class I (clear) unless otherwise indicated.

B. Tempered Float Glass: ASTM C1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class I (clear) unless otherwise indicated, Quality-Q3.

1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.

2.5 FIRE-PROTECTION-RATED GLAZING

A. Fire-Protection-Rated Glazing: Listed and labeled by a testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on positive-pressure testing in accordance with NFPA 257 or UL 9, including hose-stream test, and shall comply with NFPA 80.

1. Fire-protection-rated glazing required to have a fire-protection rating of 20 minutes shall be exempt from hose-stream test.

B. Fire-Protection-Rated Glazing Labeling: Permanently mark fire-protection-rated glazing with certification label of a testing agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name; test standard; whether glazing is permitted to be used in doors or openings; if permitted in openings, whether glazing has passed hose-stream test; whether glazing meets 450 deg F temperature-rise limitation; and fire-resistance rating in minutes.

C. Film-Faced Ceramic Glazing: Clear, ceramic flat glass; 5-mm thickness; faced on one surface with a clear glazing film; and complying with 16 CFR 1201, Category II.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Technical Glass Products; FireLite NT (Premium Grade) or comparable product by one of the following:

a. AGC Glass Company North America, Inc.
b. SAFTI FIRST Fire Rated Glazing Solutions.
c. Schott North America, Inc.

d. Vetrotech Saint-Gobain.

2.6 GLAZING ACCESSORIES

A. Provide glazing gaskets, glazing sealants, glazing tapes, setting blocks, spacers, edge blocks, and other glazing accessories that are compatible with glazing products and each other and are approved by testing agencies that listed and labeled fire-resistant glazing products with which products are used for applications and fire-protection ratings indicated.

B. Glazing Sealants for Fire-Rated Glazing Products: Neutral-curing silicone glazing sealant complying with ASTM C920, Type S, Grade NS, Class 50, Use NT. Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. Dow Corning Corporation; Dow Corning® 795 Silicone Building Sealant.
   b. GE Construction Sealants; Momentive Performance Materials Inc.; SilGlaze II SCS2800.
   c. Tremco Incorporated; Spectrem 2.

2. Sealant shall have a VOC content of 250 g/L or less.
3. Colors of Exposed Glazing Sealants:As selected by Architect from manufacturer's full range of industry colors.

C. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C1281 and AAMA 800 for products indicated below:

1. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
2. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

D. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:

1. AAMA 810.1, Type 1, for glazing applications in which tape acts as primary sealant.
2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.7 MISCELLANEOUS GLAZING MATERIALS

A. General: Provide products of material, size, and shape complying with referenced glazing standard, recommended in writing by manufacturers of glass and other glazing materials for

application indicated, and with a proven record of compatibility with surfaces contacted in installation.

B. Cylindrical Glazing Sealant Backing: ASTM C1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

C. Perimeter Insulation for Fire-Resistance-Rated Glazing: Product that is approved by testing agency that listed and labeled fire-resistant glazing product with which it is used for application and fire-protection rating indicated.

2.8 FABRICATION OF GLAZING UNITS

A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine framing, glazing channels, and stops, with Installer present, for compliance with manufacturing and installation tolerances, including those for size, squareness, and offsets at corners, and for compliance with minimum required face and edge clearances.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

B. Examine glazing units to locate fire side and protected side. Label or mark units as needed so that fire side and protected side are readily identifiable. Do not use materials that leave visible marks in the completed Work.

3.3 GLAZING, GENERAL

A. Use methods approved by testing agencies that listed and labeled fire-resistant glazing products.

B. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials unless more stringent requirements are indicated, including those in referenced glazing publications.

C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.

D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.

E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

G. Provide spacers for glass lites where length plus width is larger than 50 inches.

1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
2. Provide 1/8-inch- minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.

H. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and in accordance with requirements in referenced glazing publications.

I. Set glass lites with proper orientation so that coatings face fire side or protected side as specified.

J. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.

K. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended in writing by gasket manufacturer.

3.4 TAPE GLAZING

A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.

B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.

C. Cover vertical framing joints by applying tapes to heads and sills first and then to jambs. Cover horizontal framing joints by applying tapes to jambs and then to heads and sills.

D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.

E. Do not remove release paper from tape until right before each glazing unit is installed.

F. Apply heel bead of elastomeric sealant.

G. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.

H. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.5 GASKET GLAZING (DRY)

A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.

B. Insert soft compression gasket between glass and frame or fixed stop, so it is securely in place with joints miter cut and bonded together at corners.

C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.

D. Install gaskets so they protrude past face of glazing stops.

3.6 SEALANT GLAZING (WET)

A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.

B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.

C. Tool exposed surfaces of sealants to provide a substantial washaway from glass.

3.7 CLEANING AND PROTECTION

A. Immediately after installation, remove nonpermanent labels and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains.

1. If, despite such protection, contaminating substances do contact with glass, remove substances immediately as recommended in writing by glass manufacturer.

C. Remove and replace glass that is damaged during construction period.

3.8 FIRE-PROTECTION-RATED GLAZING SCHEDULE

A. Glass Type FPGL: 90-minute fire-protection-rated glazing; film-faced ceramic glazing .

END OF SECTION 088813

SECTION 092216 - NON-STRUCTURAL METAL 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. Non-load-bearing steel framing systems for interior partitions.
2. Suspension systems for interior ceilings and soffits.
3. Grid suspension systems for gypsum board ceilings.

B. Related Requirements:

1. Section 054000 "Cold-Formed Metal Framing" for exterior and interior load-bearing and exterior non-load-bearing wall studs; floor joists; and roof rafters and ceiling joists.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawing: Plans showing location of each stud type based on manufacturer’s limiting height tables.

1. Submit annotated limited height tables for each wall type and location.

1.4 QUALITY ASSURANCE

A. Code-Compliance Certification of Studs and Tracks: Provide documentation that framing members are certified according to the product-certification program of the Certified Steel Stud Association or the Steel Stud Manufacturers Association.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Horizontal Deflection: For wall assemblies, limited to 1/240 of the wall height based on horizontal loading of 5 lbf/sq. ft..

B. Limiting Heights: Provide minimum base metal thickness as indicated in this Section and as required to meet manufacturer's limiting height requirements.

2.2 FRAMING SYSTEMS

A. Framing Members, General: Comply with ASTM C754 for conditions indicated.

1. Steel Sheet Components: Comply with ASTM C645 requirements for steel unless otherwise indicated.
2. Protective Coating: ASTM A653/A653M, G40, hot-dip galvanized unless otherwise indicated.

B. Studs and Tracks: ASTM C645. Use either conventional steel studs and tracks or embossed, high-strength steel studs and tracks (EQ studs)..

1. Steel Studs and Tracks:

a. Manufacturers: Subject to compliance with requirements, provide one of the following:

1) CEMCO; California Expanded Metal Products Co.
2) MBA Building Supplies.
3) MRI Steel Framing, LLC.
4) Phillips Manufacturing Co.
5) Steel Network, Inc. (The).
6) Telling Industries.

b. Minimum Base-Steel Thickness for Walls: 0.0296 inch (20 gauge non-structural).
c. Minimum Base-Metal Thickness for Interior Soffits and Bulkheads: 0.0179 inch (25 gauge)
d. Depth: As indicated on Drawings.

2. Embossed, High Strength Steel Studs and Tracks: Roll-formed and embossed with surface deformations to stiffen the framing members so that they are structurally comparable to conventional ASTM C645 steel studs and tracks (EQ- equivalent gauge thickness):

a. If "EQ" studs are used, use 0.0296 inch (20 gauge non-structural studs and runners) minimum base-metal thickness steel studs at walls with abuse/impact resistant gypsum board, tile backer panels, and door/opening jambs bearing and stiffener studs. EQ studs shall not be used at those locations.
b. Products: Subject to compliance with requirements, provide one of the following:

1) CEMCO; California Expanded Metal Products Co.; Viperstud.
2) ClarkDietrich Building Systems; ProStud Drywall Framing System.
3) Marino\WARE; ViperStud Drywall Framing System.
4) MBA Building Supplies; ProStud Drywall Framing System.
5) Phillips Manufacturing Co; ViperStud Drywall Framing System.
6) Steel Network, Inc. (The); PrimeWall EQ Stud.

7) Telling Industries; ViperStud Drywall Framing System.

c. Minimum Base-Steel Thickness for walls: 0.018 inch (0.457 mm) (20 gauge equivalent).
d. Minimum Base-Metal Thickness for Interior Soffits and Bulkheads: 0.0158 inch (0.401 mm) (25 gauge equivalent).
e. Depth: As indicated on Drawings.

C. Slip-Type Head Joints: Where indicated, provide one of the following:

1. Clip System: Clips designed for use in head-of-wall deflection conditions that provide a positive attachment of studs to tracks while allowing 1-1/2-inch 2-inch 2-1/2-inch 3-inch minimum vertical movement.

a. Single Long-Leg Track System: ASTM C645 top track with 2-inch- deep flanges in thickness not less than indicated for studs, installed with studs friction fit into top track and with continuous bridging located within 12 inches of the top of studs to provide lateral bracing. Minimum Base-Metal Thickness: 0.053 inch (1.35 mm) (16 gauge).

2. Deflection Track: Steel sheet top track manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.

a. Products: Subject to compliance with requirements, provide one of the following:

1) Blazeframe Industries; Bare Slotted Track (BST/BST 2).
2) CEMCO; California Expanded Metal Products Co.; CST Slotted Deflection Track or SLP-TRK Slotted Deflection Track.
3) ClarkDietrich Building Systems; SLP-TRK Slotted Deflection Track.
4) MBA Building Supplies; Slotted Deflecto Track.
5) Metal-Lite; The System.
6) Perfect Wall, Inc.; The System Slotted Deflection Track.
7) Steel Network, Inc. (The); VertiTrack VTD.
8) Telling Industries; True-Action Slotted Track.

D. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.

1. Products: Subject to compliance with requirements, provide one of the following:

a. ClarkDietrich Building Systems; Backing Plate.
b. MRI Steel Framing, LLC; Flat Strap and Backing Plate.

2. Minimum Base-Steel Thickness: **0.0329 inch**(20 gauge – structural).

E. Cold-Rolled Channel Bridging: Steel, 0.0538-inch minimum base-steel thickness, with minimum 1/2-inch- wide flanges.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. ClarkDietrich Building Systems; U-Channel (CRC).
    b. MRI Steel Framing, LLC; U-Channel Bridging.

2. Depth:1-1/2 inches.
3. Clip Angle: Not less than 1-1/2 by 1-1/2 inches, 0.068-inch- thick, galvanized steel.

2.3 SUSPENSION SYSTEMS

A. At Contractor's option, provide either conventional ceiling suspension systems or grid suspension systems as specified in this Article.

B. Tie Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.062-inch- diameter wire, or double strand of 0.048-inch- diameter wire.

C. Hanger Attachments to Concrete:

1. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction. 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/E 488M conducted by a qualified testing agency.

    a. Uses: Securing hangers to structure.
    b. Type: Torque-controlled, expansion anchoror adhesive anchor.
    c. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B633 or ASTM F1941, Class Fe/Zn 5, unless otherwise indicated.
    d. Material for Exterior or Interior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 or Group 2 stainless-steel bolts, ASTM F593, and nuts, ASTM F594.

2. Power-Actuated Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction. 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.

D. Wire Hangers: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.16 inch in diameter.

E. Carrying Channels (Main Runners): Cold-rolled, commercial-steel sheet with a base-steel thickness of 0.0538 inch (16 gauge) and minimum 1/2-inch- wide flanges.

1. Depth: 1-1/2 inches.

F. Furring Channels (Furring Members):

1. Hat-Shaped, Rigid Furring Channels: ASTM C645, 7/8 inch deep.

a. Minimum Base-Steel Thickness: 0.0296 inch (20 gauge).

G. Grid Suspension System for Gypsum Board Ceilings: ASTM C645, direct-hung system composed of main beams and cross-furring members that interlock.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Armstrong World Industries, Inc; Drywall Grid Systems.
b. Chicago Metallic Corporation; 640/660 Drywall Ceiling Suspension.
c. United States Gypsum Company; Drywall Suspension System.

2.4 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards.

1. Fasteners for Steel Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

B. Isolation Strip at Exterior Walls: Provide the following:

1. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch thick, in width to suit steel stud size.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.

1. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.

3.3 INSTALLATION, GENERAL

A. Installation Standard: ASTM C754.

1. Gypsum Board Assemblies: Also comply with requirements in ASTM C840 that apply to framing installation.

B. Install framing and accessories plumb, square, and true to line, with connections securely fastened.

C. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.

D. Install bracing at terminations in assemblies.

E. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.4 INSTALLING FRAMED ASSEMBLIES

A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.

1. Single-Layer Application: 16 inches o.c. unless otherwise indicated.
2. Multilayer Application: 16 inches o.c. unless otherwise indicated.
3. Tile Backing Panels: 16 inches o.c. unless otherwise indicated.

B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.

C. Install studs so flanges within framing system point in same direction.

D. Install tracks at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts that penetrate partitions above ceiling.

1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install track section (for cripple studs) at head and secure to jamb studs.

    a. Install two studs at each jamb unless otherwise indicated.
    b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch clearance from jamb stud to allow for installation of control joint in finished assembly.
    c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.

3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.

E. Direct Furring:

1. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.

F. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

3.5 INSTALLING CEILING SUSPENSION SYSTEMS

A. Install suspension system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.

1. Hangers: **48 inches** o.c.
2. Carrying Channels (Main Runners): **48 inches** o.c.
3. Furring Channels (Furring Members): **16 inches** o.c.

B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.

C. Suspend hangers from building structure as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.

a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.

2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.

a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.

3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
4. Do not attach hangers to steel roof deck.
5. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
6. Do not connect or suspend steel framing from ducts, pipes, or conduit.

D. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.

E. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION 092216

SECTION 092900 - GYPSUM BOARD

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. Interior gypsum board.
2. Tile backing panels.

B. Related Requirements:

1.
2. Section 092116.23 "Gypsum Board Shaft Wall Assemblies" for metal shaft-wall framing, gypsum shaft liners, and other components of shaft-wall assemblies.
3. Section 092216 "Non-Structural Metal Framing" for non-structural steel framing and suspension systems that support gypsum board panels.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 DELIVERY, STORAGE AND HANDLING

A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

1.5 FIELD CONDITIONS

A. Environmental Limitations: Comply with ASTM C840 requirements or gypsum board manufacturer's written instructions, whichever are more stringent.

B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.

C. Do not install panels that are wet, moisture damaged, and mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E119 by an independent testing agency.

B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E90 and classified according to ASTM E413 by an independent testing agency.

2.2 INTERIOR GYPSUM BOARD

A. Gypsum Board, Type X: ASTM C1396/C1396M.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. American Gypsum.
    b. CertainTeed Corporation.
    c. Georgia-Pacific Building Products.
    d. National Gypsum Company.
    e. PABCO Gypsum.
    f. United States Gypsum Company.

2. Thickness: 1/2 inch
3. Long Edges: Tapered and featured (rounded or beveled) for prefilling.

B. Flexible Gypsum Board: ASTM C1396/C1396M. Manufactured to bend to fit radii and to be more flexible than standard regular-type gypsum board of same thickness.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. American Gypsum.
    b. CertainTeed Corporation.
    c. Georgia-Pacific Building Products.
    d. National Gypsum Company.
    e. PABCO Gypsum.
    f. United States Gypsum Company.

C. Mold-Resistant Gypsum Board: ASTM C1396/C1396M. With moisture- and mold-resistant core and paper surfaces.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. American Gypsum; M-Bloc® Shaft Liner with Mold & Moisture Resistance.
   b. CertainTeed Corporation; M2Tech Moisture & Mold Resistant Gypsum Board.
   c. Georgia-Pacific Building Products; ToughRock Mold-Guard Fireguard X.
   d. National Gypsum Company; Gold Bond Brand Fire-Shield MR Board.
   e. PABCO Gypsum; Pabco Mold Curb Plus Type X.
   f. United States Gypsum Company; USG Sheetrock® Brand Mold Tough® Gypsum Panels.

2. Core: [**As indicated**] [**1/2 inch, regular type**]
3. Long Edges: Tapered.
4. Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.

2.3 TILE BACKING PANELS

A. Glass-Mat, Water-Resistant Backing Board: ASTM C1178/C1178M, with manufacturer's standard edges.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. CertainTeed Corporation; GlasRoc Tile Backer.
   b. Georgia-Pacific Building Products; DensShield Tile Backer.
   c. National Gypsum Company; eXP Tile Backer.

2. Core: 1/2 inch, Type X.
3. Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.

2.4 TRIM ACCESSORIES

A. Interior Trim: ASTM C1047.

1. Material: Galvanized or aluminum-coated steel sheet, rolled zinc, water-activated self-adhesive beaded paper-plastic-paper design similar to CertainTeed AquaBead®, or paper-faced galvanized-steel sheet.
2. Shapes:

   a. Cornerbead.
   b. Bullnose bead.
   c. LC-Bead: J-shaped; exposed long flange receives joint compound.
   d. L-Bead: L-shaped; exposed long flange receives joint compound.
   e.
   f. Expansion (control) joint.

g. Curved-Edge Cornerbead: With notched or flexible flanges.

2.5 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C475/C475M.

B. Joint Tape:

1. Interior Gypsum Board: Paper.
2. Tile Backing Panels: As recommended by panel manufacturer.

C. Joint Compound for Interior Gypsum Board: For each coat, use formulation that is compatible with other compounds applied on previous or for successive coats.

1. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use drying-type, all-purpose compound.

a. Use setting-type compound for installing paper-faced metal trim accessories.

3. Fill Coat: For second coat, use drying-type, all-purpose compound.
4. Finish Coat: For third coat, use drying-type, all-purpose compound.
5. Skim Coat: For final coat of Level 5 finish, use drying-type, all-purpose compound or high-build interior coating product designed for application by airless sprayer and to be used instead of skim coat to produce Level 5 finish.

a. High-Build Interior Coating Products:

1) United States Gypsum Company; Sheetrock Brand Tuff-Hide Primer-Surfacer.
2) Freeman Products, Inc.; SpeedSkim™ Wall & Ceiling Skim Coating.

D. Joint Compound for Tile Backing Panels:

1. Glass-Mat, Water-Resistant Backing Panel: As recommended by backing panel manufacturer.

2.6 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.

B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.

1. Verify adhesives have a VOC content of 50 g/L or less.

C. Steel Drill Screws: ASTM C1002 unless otherwise indicated.

1. Use screws complying with ASTM C954 for fastening panels to steel members from 0.033 to 0.112 inch thick.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates including welded hollow-metal frames and support framing, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLYING AND FINISHING PANELS, GENERAL

A. Comply with ASTM C840.

B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.

C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.

D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.

E. Form control and expansion joints with space between edges of adjoining gypsum panels.

F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.

1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. in area.
2. Fit gypsum panels around ducts, pipes, and conduits.
3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch- wide joints to install sealant.

G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments. Provide 1/4- to 1/2-inch- wide spaces at these locations and trim edges with edge

trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

I. Wood Framing: Install gypsum panels over wood framing, with floating internal corner construction. Do not attach gypsum panels across the flat grain of wide-dimension lumber, including floor joists and headers. Float gypsum panels over these members or provide control joints to counteract wood shrinkage.

J. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C919 and with manufacturer's written instructions for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.

K. Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

3.3 APPLYING INTERIOR GYPSUM BOARD

A. Install interior gypsum board in the following locations:

1. Type X: Vertical surfaces unless otherwise indicated.
2. Flexible Type: As indicated on Drawings,[Apply in double layer at curved assemblies.
3. Abuse-Resistant Type: As indicated on Drawings.
4. .
5. .
6. Glass-Mat Interior Type: As indicated on Drawings.

B. Single-Layer Application:

1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing unless otherwise indicated.
2. On partitions/walls, apply gypsum panels vertically (parallel to framing unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
    a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
    b. At stairwells and other high walls, install panels horizontally unless otherwise indicated or required by fire-resistance-rated assembly.
3. On Z-shaped furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
4. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

C. Multilayer Application:

1. On ceilings, apply gypsum board indicated for base layers before applying base layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-layer joints one framing member, 16 inches minimum, from parallel base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly.
2. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
3. Fastening Methods: Fasten base layers and face layers separately to supports with screws.

D. Laminating to Substrate: Where gypsum panels are indicated as directly adhered to a substrate (other than studs, joists, furring members, or base layer of gypsum board), comply with gypsum board manufacturer's written instructions and temporarily brace or fasten gypsum panels until fastening adhesive has set.

E. Curved Surfaces:

1. Install panels horizontally (perpendicular to supports) and unbroken, to extent possible, across curved surface plus 12-inch- long straight sections at ends of curves and tangent to them.
2. For double-layer construction, fasten base layer to studs with screws 16 inches o.c. Center gypsum board face layer over joints in base layer, and fasten to studs with screws spaced 12 inches o.c.

3.4 APPLYING TILE BACKING PANELS

A. Glass-Mat, Water-Resistant Backing Panels: Comply with manufacturer's written installation instructions and install at locations indicated to receive tile. Install with 1/4-inch gap where panels abut other construction or penetrations.

B. 6Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.

3.5 INSTALLING TRIM ACCESSORIES

A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.

B. Control Joints: Install control joints at locations indicated on Drawings and according to the following:

1. Provide at each side above door frames as indicated on the Drawings.
2. Partition – Interior: 30 feet maximum spacing.
3. Ceiling – Interior with Perimeter Relief: 50 feet maximum spacing and 2,500 sq. ft. maximum single area.

4. Ceiling – Interior Without Perimeter Relief: 30 feet maximum spacing and 900 sq. ft. maximum single area.

C. Interior Trim: Install in the following locations:

1. Cornerbead: Use at outside corners unless otherwise indicated.
2. LC-Bead: Use at exposed panel edges.
3. L-Bead: Use where indicated.
4. Curved-Edge Cornerbead: Use at curved openings.

3.6 FINISHING GYPSUM BOARD

A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.

B. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.

C. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C840:

1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
2. Level 2: Panels that are substrate for tile .
3. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated.

    a. Primer and its application to surfaces are specified in Section 099123 "Interior Painting."

4. Level 5: All skylight wells, all vestibule ceilings at exterior doors, and ceilings and bulkheads at Media Center .

    a. Primer and its application to surfaces are specified in Section 099123 "Interior Painting."

D. Glass-Mat Faced Panels: Finish according to manufacturer's written instructions.

3.7 PROTECTION

A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.

B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

C. Remove and replace panels that are wet, moisture damaged, and mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 092900

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SECTION 093013 - CERAMIC TILING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Porcelain tile.
2. Waterproof membranes.
3. Crack isolation membranes.
4. Setting material.
5. Grout materials.
6. Metal Edge Strips

B. Related Requirements:

1. Section 079200 "Joint Sealants" for sealing of movement joints in tile surfaces.

1.2 DEFINITIONS

A. General: Definitions in ANSI A108 series of tile installation standards and in ANSI A137.1 apply to Work of this Section unless otherwise specified.

B. Face Size: Actual tile size, excluding spacer lugs.

C. Large Format Tile: Tile with at least one edge 15 inches or longer.

D. Module Size: Actual tile size plus joint width indicated.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review requirements in ANSI A108.01 for substrates and for preparation by other trades.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Show locations, plans, and elevations, of each type of tile and tile pattern. Show widths, details, and locations of movement joints in tile substrates and finished tile surfaces.

C. Samples for Verification:

1. Full-size units of each type and composition of tile and for each color and finish required.
2. Full-size units of each type of trim and accessory for each color and finish required.
3. Metal edge strips in 6-inch lengths.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Master Grade Certificates: For each shipment, type, and composition of tile, signed by tile manufacturer and Installer.

C. Product Certificates: For each type of product, including product use classification.

D. Product Test Reports: For tile-setting and grout product and certified porcelain tile.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Extra Stock Material: Furnish extra materials, from the same production run, to Owner that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed for each type, composition, color, pattern, and size indicated.

   a. .

2. Grout: Furnish quantity of grout equal to 3 percent of amount installed for each type, composition, and color indicated.

1.7 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installer is a Five-Star member of the National Tile Contractors Association or a Trowel of Excellence member of the Tile Contractors' Association of America.
2. Installer's supervisor for Project holds the International Masonry Institute's Supervisor Certification.
3. Installer employs only Ceramic Tile Education Foundation Certified Installers or installers recognized by the U.S. Department of Labor as Journeyman Tile Layers for Project.
4. Installer employs at least one installer for Project that has completed the Advanced Certification for Tile Installers (ACT) certification for installation of membranes and large format tile.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirements in ANSI A137.1 for labeling tile packages.

B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.

C. Store aggregates where grading and other required characteristics can be maintained and contamination can be avoided.

D. Store liquid materials in unopened containers and protected from freezing.

1.9 FIELD CONDITIONS

A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

1.10 WARRANTY

A. System Warranty: Manufacturer's non-prorated comprehensive warranty that agrees to repair and replace defective installation areas, material, and labor that fail under normal usage within specified warranty period.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Tile: Obtain tile of each type and color or finish from single source or producer.

1. Obtain tile of each type and color or finish from same production run and of consistent quality in appearance and physical properties for each contiguous area.

B. Tiling System: Obtain system products from single manufacturer and each aggregate from single source or producer.

1. Manufacturers: Subject to compliance with requirements, provide product by one of the following:

a. Custom Building Products.

b. Laticrete International, Inc.

c. MAPEI Corporation.

2.2 PRODUCTS, GENERAL

A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.

1. Provide tile complying with Standard Grade requirements unless otherwise indicated.

B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCNA installation methods specified in tile installation schedules, and other requirements specified.

C. Factory Blending: For tile exhibiting color variations within ranges, blend tile in factory and package so tile units taken from one package show same range in colors as those taken from other packages and match approved Samples.

D. Mounting: For factory-mounted tile, provide back- or edge-mounted tile assemblies as standard with manufacturer unless otherwise indicated.

1. Where tile is indicated for installation in wet areas, do not use back- or edge-mounted tile assemblies unless tile manufacturer specifies in writing that this type of mounting is suitable for installation indicated and has a record of successful in-service performance.

2.3 PORCELAIN TILE

B. T-01: Porcelain Tile. Basis of Design: Crossville, Trajectory

a. Face Size: 12 inches by 24 inches.
b. Thickness: 3/8 inches (9.5 mm)
c. Color/Finish: Flow.

C. T-02: Porcelain Tile. Basis of Design: Crossville, Moonstruck

a. Face Size: 12 inches by 24 inches.
b. Thickness: 13/32 inches (10.5 mm).
c. Color/Finish: Luna.

D. T-03: Porcelain Tile. Basis of Design: Daltile, Natural Hues

a. Face Size: 4 inches by 8 inches.
b. Thickness: inches (9.525 mm).
c. Color/Finish: Blueberry.

E. T-04: Porcelain Tile. Basis of Design: Daltile, Natural Hues

d. Face Size: 4 inches by 8 inches.
e. Thickness: inches (9.525 mm).

f. Color/Finish: Mist.

F. T-05: Porcelain Tile. Basis of Design: Daltile, Natural Hues

g. Face Size: 4 inches by 8 inches.
h. Thickness: inches (9.525 mm).
i. Color/Finish: Midnight Blue.

G. T-06: Porcelain Tile. Basis of Design: Daltile, Natural Hues

j. Face Size: 4 inches by 8 inches.
k. Thickness: inches (9.525 mm).
l. Color/Finish: Cloud.

H. T-07: Porcelain Tile. Basis of Design: Daltile, Natural Hues

m. Face Size: 4 inches by 8 inches.
n. Thickness: inches (9.525 mm).
o. Color/Finish: Iceberg.

I. T-08: Porcelain Tile. Basis of Design: Daltile, Natural Hues

p. Face Size: 4 inches by 8 inches.
q. Thickness: inches (9.525 mm).
r. Color/Finish: Carnation.

2. Basis of Design:: Subject to compliance with requirements, provide product listed in Finish Schedule on Drawing Sheet A12.0. Other available manufacturers offering acceptable equivalent products that may be incorporated into the Work include, but are not limited to the following and will be subject to compliance with size and color requirements of Basis of Design product by one of the following:<Double click here to find, evaluate, and insert list of manufacturers and products.>
   a. American Olean; a brand of Dal-Tile Corporation.
   b. Crossville, Inc.
   c. Daltile; a brand of Dal-Tile Corporation.
   d. Sark Tile.
   e. Tilebar Tile Store

3. Certification: Tile certified by the Porcelain Tile Certification Agency.
4. Grout Color: As indicated on the Finish Schedule.
5. Precoat with temporary protective coating.
6. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile. Provide shapes as follows, selected from manufacturer's standard shapes:

   a. Base Cap: Surface bullnose B-02, as found on the Finish Schedule.

2.4 WATERPROOF MEMBRANES

A. General: Manufacturer's standard product that complies with ANSI A118.10 and ANSI A118.12 and is recommended by manufacturer for application indicated. Include reinforcement and accessories recommended by manufacturer.

B. Waterproof Membrane, Fluid Applied: Liquid-latex rubber or elastomeric polymer.

1. Products: Subject to compliance with requirements, provide Mapei Mapelastic AquaDefense or comparable product by one of the following:<Double click here to find, evaluate, and insert list of manufacturers and products.>
   a. ARDEX Americas.
   b. Laticrete International, Inc.
   c. Mapei Corporation.
   d. Schluter Systems L.P.

2.5 SETTING MATERIALS

A. Polymer Modified Dry-Set Mortar (Thinset): ANSI A118.4 and A118.11.

1. <Double click here to find, evaluate, and insert list of manufacturers and products.>Basis of Design Product: Provide Mapei UltraFlex 2 or comparable product by one of the following:

   a. ARDEX Americas.

   b. Custom Building Products.

   c. H.B. Fuller Construction Products, Inc. /TEC.

   d. Laticrete International, Inc.

   e. MAPEI Corporation.

2. Provide prepackaged, dry-mortar mix containing dry, redispersible, vinyl acetate or acrylic additive to which only water must be added at Project site.
3. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to other requirements in ANSI A118.4.

B. Polymer Improved Modified Thin-Set Mortar for Large and Heavy Tile (LHT) Format:: ANSI A118.415 and A118.11.

1. Basis of Design Product: Provide Mapei Ultraflex LFT or comparable product by one of the following:<Double click here to find, evaluate, and insert list of manufacturers and products.>
2. a. ARDEX Americas.
3. b. Custom Building Products.
4. c. H.B. Fuller Construction Products Inc. / TEC.
5. d. Laticrete International, Inc.

6. e. MAPEI Corporation.
7. Provide prepackaged, dry-mortar mix containing dry, redispersible, vinyl acetate or acrylic additive to which only water must be added at Project site.
8. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to other requirements in ANSI A118.15.

2.6 GROUT MATERIALS

A. High-Performance Tile Grout: ANSI A118.7.

1. Basis-of-Design: Subject to compliance with requirements, provide Perma Color by Laticrete. Other available manufacturers offering acceptable equivalent products that may be incorporated into the Work include, but are not limited to, the following:

   a. Bostik, smart adhesives. Hydroment-Ceramic Tile Grout with 425 Admixture
   b. Custom Building Products. Prism SureColor
   c. LATICRETE International, Inc. Perma Color
   d. MAPEI. Flexcolor Design / Flexcolor CQ

B. Water-Cleanable Epoxy Grout: ANSI A118.3, with a VOC content of 65 g/L or less.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but not limited to, the following:

   a. Bostik, smart adhesives. TruColor
   b. Custom Building Products. CEG-Lite 100% solid Epoxy
   c. LATICRETE International, Inc. SpectraLock Pro Premium
   d. MAPEI. Kerapoxy CQ / Kerapoxy IEG CQ (commercial kitchen)

C. Grout for Pregrouted Tile Sheets: Same product used in factory to pregrout tile sheets.

2.7 MISCELLANEOUS MATERIALS

A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting and adhesive materials for installations indicated.

B. Waterproofing Strips: Seal floor/wall connections to ensure a fully water-tight seal preventing leaks and mold growth. Adhere tightly to inside and outside corners without rounding. Metal Flooring Transitions: Profile designed specifically for flooring applications; height to match tile and setting-bed thickness.

1. Basis of Design Product:<Double click here to find, evaluate, and insert list of manufacturers and products.>
   a. Basis of Design Product:
   1) Manufacturer: Schluter
   2) Product: Kerdi-Band

C. Metal Edge Accessory MTA-01 & 02: Provide Basis of Design product listed in Finish Schedule on Drawing Sheet A12.0 or architect approved equal by one of the following:

a. Custom Building Products.

b. Schluter Systems L.P.

D. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.

E. Grout Sealer: Grout manufacturer's standard product for sealing grout joints that does not change color or appearance of grout.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but not limited to, the following:

   a. Bostik, smart adhesives; <Insert Product>.
   b. Custom Building Products; <Insert Product>.
   c. LATICRETE International, Inc.; <Insert Product>.
   d. MAPEI; <Insert Product>.
   e. TEC® H. B. Fuller Construction Products, Inc.; <Insert Product>.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. Verify that concrete substrates for tile floors installed with thinset mortar comply with surface finish requirements in ANSI A108.01 for installations indicated.

   a. Verify that surfaces that received a steel trowel finish have been mechanically scarified.
   b. Verify that protrusions, bumps, and ridges have been removed by sanding or grinding.

2. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed.
3. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove coatings, including curing compounds or other coatings, that are incompatible with tile-setting materials.

B. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with thinset mortar with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.

C. Where indicated, prepare substrates to receive waterproof membrane by applying a reinforced mortar bed that complies with ANSI A108.1 and is sloped 1/4 inch per foot toward drains.

D. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

E. Substrate Flatness:

1. For tile shorter than 15 inches, confirm that structure or substrate is limited to variation of 1/4 inch in 10 ft. from the required plane, and no more than 1/16 inch in 12 inches when measured from tile surface high points.
2. For large format tile, tile with at least one edge 15 inches or longer, confirm that structure or substrate is limited to 1/8 inch in 10 ft. from the required plane, and no more than 1/16 inch in 24 inches when measured from tile surface high points.

F. Field-Applied Temporary Protective Coating: If indicated under tile type or needed to prevent grout from staining or adhering to exposed tile surfaces, precoat them with continuous film of temporary protective coating, taking care not to coat unexposed tile surfaces.

3.3 INSTALLATION OF CERAMIC TILE SYSTEM

A. Install tile backing panels and treat joints in accordance with ANSI A108.11 and manufacturer's written instructions for type of application indicated.

B. Install waterproof membrane to comply with ANSI A108.13 and manufacturer's written instructions to produce waterproof membrane of uniform thickness that is bonded securely to substrate.

1. Allow waterproof membrane to cure and verify by testing that it is watertight before installing tile or setting materials over it.

C. Install crack isolation membrane to comply with ANSI A108.17 and manufacturer's written instructions to produce membrane of uniform thickness that is bonded securely to substrate.

1. Allow crack isolation membrane to cure before installing tile or setting materials over it.

D. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.

1. Add materials, water, and additives in accurate proportions.
2. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

E. Install tile in accordance with TCNA's "Handbook for Ceramic, Glass, and Stone Tile Installation" for TCNA installation methods specified in tile installation schedules. Comply with parts of ANSI A108 series that are referenced in TCNA installation methods and specified in tile installation schedules, and apply to types of setting and grouting materials used.

1. For the following installations, follow procedures in ANSI A108 series of tile installation standards for providing 95 percent mortar coverage:

    a. Tile floors in wet areas.
    b. Tile floors consisting of tiles 8 by 8 inches or larger.

2. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.
3. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.
4. Provide manufacturer's standard trim shapes where necessary to eliminate exposed tile edges.
5. Where accent tile differs in thickness from field tile, vary setting-bed thickness so that tiles are flush.
6. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.

    a. For tile mounted in sheets, make joints between tile sheets same width as joints within tile sheets, so joints between sheets are not apparent in finished Work.
    b. Where adjoining tiles on floor, base, walls, or trim are specified or indicated to be same size, align joints.
    c. Where tiles are specified or indicated to be whole integer multiples of adjoining tiles on floor, base, walls, or trim, align joints unless otherwise indicated.

7. Lay out tile wainscots to dimensions indicated or to next full tile beyond dimensions indicated.

F. Movement Joints: Provide movement joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated on Drawings. Form joints during installation of setting materials, mortar beds, and tile. Keep joints free of dirt, debris, and setting materials prior to filling with sealants. Do not saw-cut joints after installing tiles.

1. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.

G. Metal Flooring Transitions: Install at locations indicated.

H. Metal Wall Trim: Install at locations indicated on Drawings.

I. Grout Sealer: Apply grout sealer to[**cementitious**] grout joints[**in tile floors**] in accordance with manufacturer's written instructions. As soon as sealer has penetrated grout joints, remove excess sealer and sealer from tile faces by wiping with soft cloth.

3.4 FIELD QUALITY CONTROL

A. Water Test:

1. Test of waterproofing membrane in showers and similar areas to be performed by Installation Contractor before setting tile.

a. Perform test after 24 hours of waterproof membrane installation.
b. Insert test plug in drain or waste line.
c. Fill shower base with water, high enough that the membrane-to-drain connection and floor-to-wall transition can be evaluated, and mark wall.
d. Check for leaks after 24 hours.

B. Nonconforming Work:

1. Waterproof membrane will be considered defective if water level has dropped.
2. Remove and replace defective components and retest.

3.5 ADJUSTING AND CLEANING

A. Remove and replace tile that is damaged or that does not match adjoining tile. Provide new matching units, installed as specified and in a manner to eliminate evidence of replacement.

B. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.

1. Remove grout residue from tile as soon as possible.
2. Clean grout smears and haze from tile in accordance with tile and grout manufacturer's written instructions. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.

3.6 PROTECTION

A. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. If recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors.

B. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.

C. Before final inspection, remove protective coverings and rinse neutral protective cleaner from tile surfaces.

END OF SECTION 093013

SECTION 096566 - RESILIENT ATHLETIC FLOORING

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. Sheet vinyl flooring.

B. Related Requirements:

1. Section 096513 "Resilient Base and Accessories" for wall base and accessories installed with resilient athletic flooring.

1.3 COORDINATION

A. Coordinate layout and installation of flooring with floor inserts for gymnasium equipment.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Show installation details and locations of the following:

1. Floor patterns.
2. Layout, colors, widths, and dimensions of game lines and markers.
3. Locations of floor inserts for athletic equipment installed through flooring.
4. Seam locations for sheet flooring.

C. Samples: For each exposed product and for each type, color, and pattern specified, 6-inch-square in size and of the same thickness indicated for the Work.

1. Game-Line- and Marker-Paint Samples: Include Sample sets showing game-line- and marker-paint colors applied to flooring.
2. Seam Samples: For each vinyl sheet flooring color and pattern required; with seam running lengthwise and in center of 6-by-9-inch Sample applied to a rigid backing and prepared by Installer for this Project.

D. Samples for Initial Selection: For each type of resilient athletic flooring.

1. Game-Line and Marker Paint: Include charts showing available colors and glosses.

E. Samples for Verification: For each type, color, and pattern of flooring specified, 6-inch- square in size and of same thickness and material indicated for the Work.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For sheet vinyl flooring Installer.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For resilient athletic flooring to include in maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Sheet Flooring: Furnish full-width rolls of not less than 10 linear feet for each 500 linear feet or fraction thereof, of each type, color, and pattern of flooring installed.

1.8 QUALITY ASSURANCE

A. Sheet Vinyl Flooring Installer Qualifications: An experienced installer who has completed sheet vinyl flooring installations using seaming methods indicated for this Project and similar in material, design, and extent to that indicated for this Project; who is acceptable to manufacturer; and whose work has resulted in installations with a record of successful in-service performance.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating brand name and directions for storing.

B. Store materials to prevent deterioration.

1. Store rolls upright.

1.10 FIELD CONDITIONS

A. Adhesively Applied Products:

1. Maintain temperatures during installation within range recommended in writing by manufacturer, but not less than 65 deg F or more than 895 deg F , in spaces to receive flooring 48 hours before installation, during installation, and 48 hours after installation unless longer period is recommended in writing by manufacturer.

2. After postinstallation period, maintain temperatures within range recommended in writing by manufacturer, but not less than 55 deg F or more than [**85 deg F**] .
3. Close spaces to traffic during flooring installation.
4. Close spaces to traffic for 48 hours after flooring installation unless manufacturer recommends longer period in writing.

B. Install flooring after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. MR Credits: For products having recycled content, indicate percentage by weight of post-consumer and pre-consumer recycled content.>

B. IEQ Credits: For adhesives and flooring , including a statement of VOC content.

C. ASTM F 2772-11 Indoor Sport Floor Standard:

a. Provide certification of compliance for the four ASTM F2772 Indoor Sport Floor Standard performance categories:

1) Shock Absorption/Force Reduction:

a) Class C3 (34% to 46%). Pass

2) Ball Bounce:

a) Minimum 90%: Pass

3) Surface effect/Coefficient of Friction:

a) Between 80-110: Pass

4) Vertical deformation:

a) Maximum 3.5mm: Pass

2. Resistance to Rolling Load: EN 1569; Pass.
3. Chemical Resistance: ASTM D 543; OK.
4. Impact Resistance: EN 1517; Pass.
5. Abrasion Resistance: EN ISO 5470; Pass.
6. Sound Insulation: EN ISO 717; 18 dB.
7. Gloss/Brightness: EN ISO 2813; Pass.
8. Organic Emission: ASTM D 5116; Pass
9. Fire Performance: ASTM E 648; Greater than 0.45 W/cm2, Class 1.
10. Surface Maintenance Requirements: No-wax surface requiring only cleaning and rinsing.

11. Slab Moisture Tolerance Installed with Vented Slip-Sheet System: Maximum relative humidity (RH) of 92% when tested according to ASTM F 2170.

2.2 SHEET VINYL FLOORING – RF-01

A. Product -,Base Bid, Basis of Design: Gerflor – Taraflex Sport M Plus

1. Description: Sheet vinyl flooring specifically designed for loose-lay athletic flooring applications.
2. Sheet Vinyl Flooring with Backing: ASTM F1303.
3. Wear-Layer Thickness: Grade 1.
4. Overall Thickness: 0.3 inch (7.5 mm)..
5. Interlayer Material: Foamed plastic.
6. Backing Class: Class C (foamed plastic).
7. Seaming Method: Heat welded.
8. Traffic-Surface Texture: Wood Grain Embossed.
9. Applied Finish: Factory-applied UV urethane.
10. Roll Size: **Not less** 59 inches (1.5 m) wide by 86 feet, 6 inches (24.6 m)long to minimize splicing during installation.
11. Color and Pattern: As selected by Architect from manufacturer's full range.

B. Product, Alternate No. 1, Basis of Design: Gerflor – Taraflex Sport M Plus

1. Description: Sheet vinyl flooring specifically designed for loose-lay athletic flooring applications.
2. Sheet Vinyl Flooring with Backing: ASTM F1303.
3. Wear-Layer Thickness: Grade 1.
4. Overall Thickness: 0.244 inch (6.2 mm)..
5. Interlayer Material: Foamed plastic.
6. Backing Class: Class C (foamed plastic).
7. Seaming Method: Heat welded.
8. Traffic-Surface Texture: Wood Grain Embossed.
9. Applied Finish: Factory-applied UV urethane.
10. Roll Size: **Not less** 59 inches (1.5 m) wide by 86 feet, 6 inches (24.6 m)long to minimize splicing during installation.
11. Color and Pattern: As selected by Architect from manufacturer's full range.

2.3 VENTED SLIP-SHEET LOOSE-LAY UNDERLAYMENT SYSTEM:

A. Basis-of-Design Product: Gerflor Taraflex Isolsport.

B. Description: Vented slip-sheet vinyl layer installed between the substrate and resilient athletic flooring.

1. Bottom Texture: Raised texture on the bottom side permits moderate moisture vapor emissions to escape and vent. Systems that are smooth or have indented texture on the bottom side are not acceptable.
2. Overall Thickness: Not less than 1.65 mm.

3. Roll Length: Not less than 147 feet, 6 inches (45 m).
4. Roll Width: Not less than 78 inches (2 m).
5. Installation Method: Loose laid over existing floor or other substrate.

C. Performance Criteria:

1. Fire Performance Classification: ASTM E 648, Class 1.
2. Slab Moisture Design Tolerance: Maximum relative humidity (RH) of 92% when tested according to ASTM F 2170.

D.

2.4 ACCESSORIES

A. Trowelable Leveling and Patching Compound: Latex-modified, hydraulic-cement-based formulation approved by flooring manufacturer.

B. Adhesives: Water-resistant type recommended in writing by manufacturer for substrate and conditions indicated.

C. Game-Line and Marker Paint: Complete system including primer, if any, compatible with flooring and recommended in writing by flooring and paint manufacturers for use indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

3.2 PREPARATION

A. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended in writing by manufacturer. Do not use solvents.

B. Use trowelable leveling and patching compound to fill cracks, holes, and depressions in substrates.

C. Move flooring and installation materials into spaces where they will be installed at least 48 hours in advance of installation unless manufacturer recommends a longer period in writing.

1. Do not install flooring until it is the same temperature as space where it is to be installed.

D. Sweep and vacuum clean substrates to be covered by flooring immediately before installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation, and dust. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 FLOORING INSTALLATION, GENERAL

A. Comply with manufacturer's written installation instructions.

B. Scribe, cut, and fit flooring to butt neatly and tightly to vertical surfaces, equipment anchors, floor outlets, and other interruptions of floor surface.

C. Extend flooring into toe spaces, door reveals, closets, and similar openings unless otherwise indicated.

D. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating subfloor markings on flooring. Use nonpermanent, nonstaining marking device.

3.4 SHEET FLOORING INSTALLATION

A. Unroll sheet flooring and allow it to stabilize before cutting and fitting.

B. Lay out sheet flooring as follows:

1. Maintain uniformity of flooring direction.
2. Minimize number of seams; place seams in inconspicuous and low-traffic areas, at least 6 inches away from parallel joints in flooring substrates.
3. Match edges of flooring for color shading at seams.
4. Locate seams according to approved Shop Drawings.

C. Adhere products to substrates using a full spread of adhesive applied to substrate to comply with adhesive and flooring manufacturers' written instructions, including those for trowel notching, adhesive mixing, and adhesive open and working times.

1. Provide completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

D. Vinyl Sheet Flooring Seams: Prepare and finish seams to produce surfaces flush with adjoining flooring surfaces.

1. Heat-Welded Seams: Comply with ASTM F1516. Rout joints and use welding bead to permanently fuse sections into a seamless flooring.

3.5 GAME LINES AND MARKERS

A. Mask flooring at game lines and markers, and apply paint to produce sharp edges. Where crossing, break minor game line at intersection; do not overlap lines.

B. Apply game lines and markers in widths and colors according to requirements indicated on Drawings.

3.6 FIELD-APPLIED FINISHES

A. Apply finish after game-line and marker paint is fully cured.

B. Apply finish according to manufacturer's written instructions to produce a sealed surface that is ready for use.

C. Do not cover flooring after finishing until finish reaches full cure.

3.7 CLEANING AND PROTECTION

A. Perform the following operations immediately after completing flooring installation:

1. Remove adhesive and other blemishes from flooring surfaces.
2. Sweep and vacuum flooring thoroughly.
3. Damp-mop flooring to remove marks and soil after time period recommended in writing by manufacturer.

B. Protect flooring from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period. Use protection methods recommended in writing by manufacturer.

1. Do not move heavy and sharp objects directly over flooring. Protect flooring with plywood or hardboard panels to prevent damage from storing or moving objects over flooring.

END OF SECTION 096566

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SECTION 098433 - SOUND-ABSORBING WALL UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes shop-fabricated, acoustical panel units tested for acoustical performance, including the following:

1. Sound-absorbing wall panels.

B. Related Requirements:

1. Section 061000 “Rough Carpentry for wood furring systems.

1.3 DEFINITIONS

A. NRC: Noise Reduction Coefficient.

B. SAA: Sound Absorption Average.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For unit assembly and installation.

1. Include plans, elevations, sections, and mounting devices and details.
2. Include details at panel head, base, joints, and corners; and details at ceiling, floor base, and wall intersections. Indicate panel edge profile and core materials.
3. Include details at cutouts and penetrations for other work.

C. Samples for Initial Selection: For each type of fabric facing.

1. Include Samples of hardware and accessories involving color or finish selection.

D. Samples for Verification: For the following products:

1. Panel Edge: 12-inch- long Sample(s) showing each edge profile, corner, and finish.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Elevations and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Electrical outlets, switches, and thermostats.
2. Items penetrating or covered by units including the following:

a. Lighting fixtures.
b. Air outlets and inlets.
c. Speakers.
d. Alarms.
e. Sprinklers.
f. Access panels.

3. Show operation of hinged and sliding components covered by or adjacent to units.

B. Sample Warranty: For manufacturer's special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of unit to include in maintenance manuals. Include fabric manufacturers' written cleaning and stain-removal instructions.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials from same production run that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Panels: For each color and finish installed, provide panels equal to 10 percent of amount installed, but no fewer than 10 panels.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Comply with fabric and unit manufacturers' written instructions for minimum and maximum temperature and humidity requirements for shipment, storage, and handling.

B. Deliver materials and units in unopened bundles and store in a temperature-controlled dry place with adequate air circulation.

1.9 FIELD CONDITIONS

A. Environmental Limitations: Do not install units until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work at and 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 units until a permanent level of lighting is provided on surfaces to receive the units.

C. Air-Quality Limitations: Protect units from exposure to airborne odors, such as tobacco smoke, and install units under conditions free from odor contamination of ambient air.

D. Field Measurements: Verify unit locations and actual dimensions of openings and penetrations by field measurements before fabrication, and indicate them on Shop Drawings.

1.10 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace units and components that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to the following:

a. Acoustical performance.
b. Material defects including panel breakage.

2. Warranty Period: Lifetime from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain wall units specified in this Section from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: Units shall comply with "Surface-Burning Characteristics" or "Fire Growth Contribution" Subparagraph below, or both, as determined by testing identical products by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:

1. Surface-Burning Characteristics: Comply with ASTM E84 or UL 723; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

a. Flame-Spread Index: 25 or less.
b. Smoke-Developed Index: 450 or less.

2. Fire Growth Contribution: Comply with acceptance criteria of local code and authorities having jurisdiction when tested according to NFPA 265 Method B Protocol or NFPA 286.

2.3 SOUND-ABSORBING WALL UNITS

A. Sound-Absorbing Wall Panel AP-01, AP-02 : Manufacturer's standard panel construction consisting of wood fiber core.

B. Manufacturers: Basis of Design: Subject to compliance with requirements, provide Cardinal Acoustics, Inc. Cardinal Complete or comparable product by one of the following:

1. Martin Fireproofing Corporation.
2. Tectum; an Armstrong World Industries brand.

C. Panel Characteristics:

1. Panel Shape: As indicated on Drawings.
2. Mounting: Back mounted with manufacturer's standard in furring strips secured to substrate.
3. Core: Wood Fiberboard
4. Edge Construction: Manufacturer's standard .
5. Edge Profile: Chamfered (beveled).
6. Corner Detail in Elevation: Square with continuous edge profile indicated.
7. Acoustical Performance: Sound absorption NRC of not less than 0.90 according to ASTM C423 for Type A mounting according to ASTM E795.
8. Nominal Overall Panel Thickness: 1 inch.
9. Panel Width: As indicated on Drawings.
10. Panel Height: As indicated on Drawings.

2.4 MATERIALS

A. Composite Wood Products: Verify products are made using ultra-low-emitting formaldehyde resins, as defined in the California Air Resources Board's "Airborne Toxic Control Measure to Reduce Formaldehyde Emissions from Composite Wood Products," or are made with no added formaldehyde.

B. Core Materials:[Manufacturer's standard.]

2.5 FABRICATION

A. Standard Construction: Use manufacturer's standard construction unless otherwise indicated.

B. Dimensional Tolerances of Finished Units: Plus or minus 1/16 inch for the following:

1. Thickness.
2. Edge straightness.
3. Overall length and width.
4. Squareness from corner to corner.
5. Chords, radii, and diameters.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine acoustical units, substrates, areas, and conditions for compliance with requirements, installation tolerances, and other conditions affecting unit performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install units in locations indicated. Unless otherwise indicated, install units with vertical surfaces and edges plumb, top edges level and in alignment with other units, faces flush, and scribed to fit adjoining work accurately at borders and at penetrations.

B. Comply with manufacturer's written instructions for installation of units using type of mounting devices indicated. Mount units securely to supporting substrate.

3.3 INSTALLATION TOLERANCES

A. Variation from Plumb and Level: Plus or minus 1/16 inch in 48 inches, noncumulative.

3.4 CLEANING

A. Clean panels on completion of installation to remove dust and other foreign materials according to manufacturer's written instructions.

END OF SECTION 098433

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SECTION 099123 - INTERIOR PAINTING

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 surface preparation and the application of paint systems on the following interior substrates:

1. Concrete.
2. Concrete masonry units (CMUs).
3. Steel and iron.
4. Galvanized metal.
5. Wood.
6. Gypsum board.
7. Plaster.
8. Cotton or canvas insulation covering.
9. ASJ insulation covering.

B. This Section includes covering and protection of exposed wires, cables and interior of electrical outlet boxes. Do not paint wires, cables and interior of electrical boxes. If specified items are painted, they cannot be cleaned. Cost of materials and labor to remove and replace will be paid by the contractor performing work of this Section.

C. Related Requirements:

1. Section 051200 "Structural Steel Framing" for shop priming structural steel.
2. Section 055000 "Metal Fabrications" for shop priming metal fabrications with primers specified in this Section.
3. Section 055113 "Metal Pan Stairs" for shop priming metal pan stairs with primers specified in this Section.
4. Section 055213 "Pipe and Tube Railings" for shop priming pipe and tube railings with primers specified in this Section.
5. Section 099600 "High-Performance Coatings"

1.3 DEFINITIONS

A. MPI Gloss Level 1: Not more than five units at 60 degrees and 10 units at 85 degrees, according to ASTM D523.

B. MPI Gloss Level 2: Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D523.

C. MPI Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D523.

D. MPI Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D523.

E. MPI Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D523.

F. MPI Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D523.

G. MPI Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D523.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product. Include preparation requirements and application instructions.

1. Include Printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.
2. Indicate VOC content.

B. Samples for Verification: For each type of paint system and in each color and gloss of topcoat.

1. Submit Samples on rigid backing, 8 inches square.
2. Apply coats on Samples in steps to show each coat required for system.
3. Label each coat of each Sample.
4. Label each Sample for location and application area.

C. Product List: Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules. Include color designations.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Paint: Not less than 1 gal. of each material and color applied.

1.6 QUALITY ASSURANCE

A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Architect will select one surface to represent surfaces and conditions for application of each paint system.

    a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft..
    b. Other Items: Architect will designate items or areas required.

2. Final approval of color selections will be based on mockups.

    a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.

3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.8 FIELD CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.

B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the work include, but not limited to, the following;

1. Benjamin Moore.

2. PPG Paints; PPG Industries Inc.

3. Sherwin-Williams Company.

4. Valspar Corporation.

2.2 PAINT, GENERAL

A. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products Lists."

B. Material Compatibility:

1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.

C. VOC Content: For field applications that are inside the weatherproofing system, verify paints and coatings comply with VOC content limits of authorities having jurisdiction and the following VOC content limits:

1. Flat Paints and Coatings: 50 g/L.
2. Nonflat Paints and Coatings: 50 g/L.
3. Dry-Fog Coatings: 150 g/L.
4. Primers, Sealers, and Undercoaters: 100 g/L.
5. Rust-Preventive Coatings: 100 g/L.
6. Zinc-Rich Industrial Maintenance Primers: 100 g/L.
7. Pretreatment Wash Primers: 420 g/L.
8. Shellacs, Clear: 730 g/L.
9. Shellacs, Pigmented: 550 g/L.

D. Colors: As indicated in a color schedule at the end of Part 3.

2.3 SOURCE QUALITY CONTROL

A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure:

1. Owner may engage the services of a qualified testing agency to sample paint materials. Contractor will be notified in advance and may be present when samples are taken. If paint materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
2. Testing agency will perform tests for compliance with product requirements.
3. Owner may direct Contractor to stop applying paints if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

1. Concrete: 12 percent.
2. Masonry (Clay and CMUs): 12 percent.
3. Wood: 15 percent.
4. Gypsum Board: 12 percent.
5. Plaster: 12 percent.

C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.

D. Plaster Substrates: Verify that plaster is fully cured.

E. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.

F. Proceed with coating application only after unsatisfactory conditions have been corrected.

1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.

D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.

E. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceeds that permitted in manufacturer's written instructions.

F. Steel Substrates: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer but not less than the following:

1. SSPC-SP 2.
2. SSPC-SP 3, Power Tool Cleaning.

G. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

H. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

I. Wood Substrates:

1. Scrape and clean knots, and apply coat of knot sealer before applying primer.
2. Sand surfaces that will be exposed to view, and dust off.
3. Prime edges, ends, faces, undersides, and backsides of wood.
4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.

J. Cotton or Canvas Insulation Covering Substrates: Remove dust, dirt, and other foreign material that might impair bond of paints to substrates.

3.3 APPLICATION

A. Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual."

1. Use applicators and techniques suited for paint and substrate indicated.
2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.

B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.

C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

E. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:

1. General: Cover and protect items not specified to be painted prior to priming. Do not paint exposed wires, cables and interior of electrical outlet boxes or conductors.
2. Paint the following work where exposed in equipment rooms, unless otherwise indicated. Do not paint in unfinished rooms as indicated on Room Finish Schedule.:

    a. Equipment, including panelboards.
    b. Uninsulated metal piping.
    c. Uninsulated plastic piping.
    d. Pipe hangers and supports.
    e. Metal conduit.
    f. Plastic conduit.
    g. Tanks that do not have factory-applied final finishes.
    h. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.

3. Paint the following work where exposed in occupied spaces and where exposed above partial ceilings, clouds or suspended structure:

    a. Panelboardfronts.
    b. Uninsulated metal piping.
    c. Uninsulated plastic piping.
    d. Pipe hangers and supports.
    e. Metal conduit.
    f. Plastic conduit.
    g. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
    h. Speakers if noted to match adjacent surface
    i. Other items as directed by Architect.

4. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.
5. Do not paint or allow overspray of mechanical and electrical equipment and conduits not indicated to be painted.

3.4 FIELD QUALITY CONTROL

A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.

1. Contractor shall touch up and restore painted surfaces damaged by testing.
2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 INTERIOR PAINTING SCHEDULE

A. Concrete Substrates, Nontraffic Surfaces:

1. Institutional Low-Odor/VOC Latex System MPI INT 3.1M:

   a. Prime Coat: Primer sealer, interior, institutional low odor/VOC, MPI #149.
   b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
   c. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 3), MPI #145.

B. CMU Substrates:

1. Institutional Low-Odor/VOC Latex System MPI INT 4.2E:

   a. Block Filler: Block filler, latex, interior/exterior, MPI #4.
   b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
   c. Topcoat: Latex, interior, institutional low odor/VOC, eggshell (MPI Gloss Level 3), MPI #145.

C. Steel Substrates:

1. Water-Based Light Industrial Coating System MPI INT 5.1B:

   a. Prime Coat: Primer, rust-inhibitive, water based MPI #107.
   b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.

c. Topcoat: Light industrial coating, interior, water based, semi-gloss (MPI Gloss Level 5), MPI #153.

D. Galvanized-Metal Substrates:

1. Water-Based Light Industrial Coating System MPI INT 5.3K:

a. Prime Coat: Primer, galvanized, water based, MPI #134.
b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
c. Topcoat: Light industrial coating, interior, water based, semi-gloss (MPI Gloss Level 5), MPI #153.

E. Wood Substrates: .

1. Institutional Low-Odor/VOC Latex System [**MPI INT 6.4T**]:

a. Prime Coat: Primer, latex, for interior wood[**, MPI #39**].
b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
c. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 2)[**, MPI #144**].

F. Gypsum Board Substrates:

1. Institutional Low-Odor/VOC Latex System MPI INT 9.2M:

a. Prime Coat: Primer sealer, interior, institutional low odor/VOC, MPI #149.
b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
c. Topcoat: Latex, interior, institutional low odor/VOC, eggshell (MPI Gloss Level 3), MPI #145.

G. Acoustic Panels and Tiles:

1. Institutional Low-Odor/VOC Latex System [**MPI INT 9.3D**]:

a. Prime Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
b. Topcoat: Latex, interior, institutional low odor/VOC, flat (MPI Gloss Level 1)[**, MPI #143**].
c. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 2)[**, MPI #144**].

H. Cotton or Canvas and ASJ Insulation-Covering Substrates: Including pipe and duct coverings.

1. Institutional Low-Odor/VOC Latex System MPI INT 10.1D:

a. Prime Coat: Primer sealer, latex, interior, MPI #50.
b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
c. Topcoat: Latex, interior, institutional low odor/VOC, flat (MPI Gloss Level 1), MPI #143.

1)

3.7 PAINT COLOR SCHEDULE

A. Paint (P):

1. P-01:

   a. Manufacturer: Benjamin Moore
   b. Color: White CC-20

2. P-02:

   a. Manufacturer: Benjamin Moore
   b. Color: Match RGB Value: R-9, G-35, B-82 (Navy)

3. P-03:

   a. Manufacturer: Benjamin Moore
   b. Color: Match RGB Value: R-128, G-130, B-133 Gray

Surface	Color	Sheen

B. Interior Color Selections:

1. Exposed Concrete and Precast Concrete Ceilings, including conduits, junction boxes, pendants, pipe, fittings, ducts, diffusers, grilles, registers, etc.: As noted on Drawings Eggshell or Satin
2. CMU Walls, [**except graphics**]: As noted on Drawings Eggshell or Satin
3. Exposed Structure: Steel Deck, Joists, Bridging, Structural Steel, Conduits, Junction Boxes, Pendants, Pipe, Fittings, Ducts, Diffusers, Grilles, Registers, etc.: As noted on Drawings Eggshell or Satin
4. Exposed Joists As noted on Drawings Eggshell or Satin
5. Steel Columns, Room : As noted on Drawings Eggshell or Satin
6. Other Structural Steel: As noted on Drawings Eggshell or Satin
7. Metal Handrails and Brackets: As noted on Drawings Eggshell or Satin
   Glued-Laminated Beams:
8. Telecomm Plywood Backing Panels: Match Surface on which it occurs
9. Hollow Metal Doors : As noted on Drawings Eggshell or Satin
10. Metal Frames : As noted on Drawings Eggshell or Satin
11. Wall Access Doors: Match Surface on which it occurs
12. Ceiling Access Doors: Match Surface on which it occurs
13. Overhead Coiling Door and Guides: As noted on Drawings Eggshell or Satin
14. Gypsum Board: As noted on on Drawings Eggshell or Satin

	(unpainted portion of grid tees, suspension wire, etc.):		
15.	Mechanical and Electrical Items: Registers, Grilles, Steel-Encased Heating Units, Heating and Water Pipes, Electrical Conduits, Outlet Boxes and Panelboard Fronts Exposed in Finished Rooms	Match surface on on which it occurs.	
16.	Inside of Ductwork Exposed to View Through Registers and Grilles:	Black	Flat

END OF SECTION 099123

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SECTION 099600 - HIGH-PERFORMANCE COATINGS

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 surface preparation and the application of high-performance coating systems on the following substrates:

1. Exterior Substrates:

a. Steel.
b. Galvanized metal.

2. Interior Substrates:

a. Concrete masonry units (CMUs) – Gym walls.

B. Related Requirements:

1. Section 099123 "Interior Painting" for general field painting.

1.3 DEFINITIONS

A. MPI Gloss Level 4 (“satinlike”): 20 to 35 units at 60 degrees, according to ASTM D 523.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product. Include preparation requirements and application instructions.

1. Indicate VOC content.

B. Samples for Verification: For each type of coating system and each color and gloss of topcoat indicated.

1. Submit Samples on rigid backing, 8 inches square.
2. Apply coats on Samples in steps to show each coat required for system.

3. Label each coat of each Sample.
4. Label each Sample for location and application area.

C. Product List: Cross-reference to coating system and locations of application areas. Use same designations indicated on Drawings and in schedules. Include color designations.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Coatings: Not less than **1 gal.** of each material and color applied.

1.6 QUALITY ASSURANCE

A. Mockups: Apply mockups of each coating system indicated to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Architect will select one surface to represent surfaces and conditions for application of each coating system.

a. Wall and Ceiling Surfaces: Provide samples of at least 100 sq. ft..
b. Other Items: Architect will designate items or areas required.

2. Final approval of color selections will be based on mockups.

a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.

3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.8 FIELD CONDITIONS

A. Apply coatings only when temperature of surfaces to be coated and ambient air temperatures are between 50 and 95 deg F.

B. Do not apply coatings when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

C. Do not apply exterior coatings in snow, rain, fog, or mist.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide one of the products for each manufacturer listed in Part 2 Articles and the Interior High-Performance Coating Schedule for the coating category indicated.

2.2 HIGH-PERFORMANCE COATINGS, GENERAL

A. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products Lists."

B. Material Compatibility:

1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.
3. Products shall be of same manufacturer for each coat in a coating system.

C. VOC Content: For field applications that are inside the weatherproofing system, verify paints and coatings comply with VOC content limits of authorities having jurisdiction and the following VOC content limits:

1. Flat Paints and Coatings: 50 g/L.
2. Nonflat Paints and Coatings: 50 g/L.
3. Primers, Sealers, and Undercoaters: 100 g/L.
4. Rust-Preventive Coatings: 100 g/L.
5. Zinc-Rich Industrial Maintenance Primers: 100 g/L.
6. Pretreatment Wash Primers: 420 g/L.
7. Floor Coatings: 50 g/L.
8. Shellacs, Clear: 730 g/L.
9. Shellacs, Pigmented: 550 g/L.

D. Colors: As indicated in color schedule at the end of Part 3.

2.3 SOURCE QUALITY CONTROL

A. Testing of Coating Materials: Owner reserves the right to invoke the following procedure:

1. Owner will may the services of a qualified testing agency to sample coating materials. Contractor will be notified in advance and may be present when samples are taken. If coating materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
2. Testing agency will perform tests for compliance with product requirements.
3. Owner may direct Contractor to stop applying coatings if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying coating materials from Project site, pay for testing, and recoat surfaces coated with rejected materials. Contractor will be required to remove rejected materials from previously coated surfaces if, on recoating with complying materials, the two coatings are incompatible.

2.4 BLOCK FILLERS

A. Block Filler, Epoxy, Interior/Exterior:

1. Tnemec Series 1254 EpoxoBlock WB.

    a. VOC: 1 grams/litre.

2. PPG Paint Amercoat 114A.

    a. VOC: 0 grams/litre.

3. Sherwin-Williams, B42W400 Series Kem Cati Coat HS Epoxy Filler Sealer.

    a. VOC: < 250 grams/litre.

2.5 METAL PRIMERS

A. Primer, Zinc-Rich, Epoxy:

1. Tnemec Series 94H20 Hydro-Zinc.

    a. VOC: 97 grams/litre.

2. PPG Paint Amercoat 68HS.

    a. VOC: 288 grams/litre.

3. Sherwin-Williams, B69 Series Zinc Clad V Organic Zinc-Rich Epoxy Primer.

    a. VOC: < 50 grams/litre.

2.6 EPOXY COATINGS

A. Epoxy, High-Build, Satin:

1. Tnemec Series 66 Hi-Build Epoxoline.

a. VOC: 362 grams/litre.

2. PPG Paint Aquapon HB SG Epoxy 97-130.

a. VOC: 362 grams/litre.

3. Sherwin-Williams, B58-610 Series Macropoxy 646 Fast Cure Epoxy.

a. VOC: <250 grams/litre.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

1. Masonry (Clay and CMUs): 12 percent.

C. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.

D. Proceed with coating application only after unsatisfactory conditions have been corrected.

1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and coating systems indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

C. Clean substrates of substances that could impair bond of coatings, including dust, dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce coating systems indicated.

D. Masonry Substrates: Remove efflorescence and chalk. Do not coat surfaces if moisture content, alkalinity of surfaces, or alkalinity of mortar joints exceeds that permitted in manufacturer's written instructions.

E. Steel Substrates: Remove rust, loose mill scale, and shop primer if any. Clean using methods recommended in writing by paint manufacturer[**.**][but not less than the following:]

1. SSPC-SP 6/NACE No. 3.

F. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

G. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied coatings but not less than the following:.

3.3 APPLICATION

A. Apply high-performance coatings according to manufacturer's written instructions.

1. Use applicators and techniques suited for coating and substrate indicated.
2. Coat surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, coat surfaces behind permanently fixed equipment or furniture with prime coat only.
3. Coat backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
4. Do not apply coatings over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.

B. If undercoats or other conditions show through final coat, apply additional coats until cured film has a uniform coating finish, color, and appearance.

C. Apply coatings to produce surface films without cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections. Produce sharp glass lines and color breaks.

3.4 FIELD QUALITY CONTROL

A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test coatings for dry film thickness.

1. Contractor shall touch up and restore coated surfaces damaged by testing.
2. If test results show that dry film thickness of applied coating does not comply with coating manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with coating manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing coating application, clean spattered surfaces. Remove spattered coatings by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from coating operation. Correct damage to work of other trades by cleaning, repairing, replacing, and recoating, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced coated surfaces.

3.6 EXTERIOR HIGH-PERFORMANCE COATING SCHEDULE

A. Steel Substrates:

1. Fluoropolymer System over Polyurethane and Zinc Rich Primer:

    a. Surface Preparation: SSPC SP 6 Commercial Blast.
    b. Prime Coat:

        1) Tnemec Series 94H2O Hydro-Zinc at 2.5 to 3.0 dry mils.
        2) PPG Paint Amercoat 68HS at 2.0 to 5.0 dry mils.
        3) Sherwin Williams B69 Series Zinc Clad V Organic Zinc-Rich Epoxy Primer at 3.0 to 5.0 dry mils.

    c. Intermediate Coat:

        1) Tnemec Series 73 Endura-Shield at 2.5 to 3.0 dry mils.
        2) PPG Paint Pitthane HB Semi-Gloss 95-8800 at 2.0 to 5.0 dry mils.
        3) Sherwin Williams B65-600 Series Acrolon 218 HS Acrylic Polyurethane at 3.0 to 6.0 dry mils.

    d. Topcoat:

        1) Semi-gloss, Tnemec Series 1071 Fluoronar at 2.5 to 3.0 dry mils.
        2) Gloss, PPG Paint Coraflon ADS at 1.5 to 2.2 dry mils.
        3) High gloss, Sherwin Williams B65-500 Series Fluorokem Fluoropolymer Urethane at 2.0 to 3.0 dry mils.

B. Galvanized-Metal Substrates:

1. Fluoropolymer Finish over Epoxy Primer:

a. Surface Preparation: SSPC SP 7 Brush Blast to remove oxides and etch surface.
b. Prime Coat:

1) Tnemec Series 66 Hi-Build Epoxoline at 2.5 to 3.0 dry mils.
2) PPG Paint Aquapon HB SG Epoxy 97-130 at 4.0 to 6.0 dry mils.
3) Sherwin Williams B58-610 Series Macropoxy 646 Fast Cure Epoxy at 3.0 to 5.0 dry mils.

c. Topcoat:

1) Semi-gloss, Tnemec Series 1071 Fluoronar at 2.5 to 3.0 dry mils.
2) Gloss, PPG Paint Coraflon ADS at 1.5 to 2.2 dry mils.
3) Sherwin Williams B65-500 Series Fluorokem Fluoropolymer Urethane at 2.0 to 3.0 dry mils.

3.7 INTERIOR HIGH-PERFORMANCE COATING SCHEDULE

A. CMU Substrates:

1. Epoxy System **MPI INT 4.2F**:

a. Block Filler:

1) Block filler, epoxy, Tnemec Series 1254 EpoxoBlock WB at 80 to 120 sq. ft./gal.
2) PPG Paint Amercoat 114A at coverage rate to fill surface but not less than 5.0 dry mils.
3) Sherwin Williams B42W400 Series Kem Cati Coat HS Epoxy Filler Sealer at 10.0 to 20.0 dry mils.

b. Topcoat:

1) Epoxy, satin, Tnemec Series 287 Enviro-Pox at 225 to 250 sq. ft./gal.
2) Satin, PPG Paint Amerlock 2VOC at 4.0 to 8.0 dry mils.
3) Sherwin Williams (satin) B58-620 Series Macropoxy 646-100 Fast Cure Epoxy at 5.0 to 10.0 dry mils.

B. Steel Substrates: Match Fluoropolymer System over Polyurethane and Zinc Rich Primer for exterior installations.

C. Galvanized-Metal Substrates: Match Fluoropolymer Finish over Epoxy Primer specified for exterior installation

3.8 HIGH PERFORMANCE COATINGS COLOR SCHEDULE

A. High Performance Coating (HPC): Match Paint (P) colors as specified in Section 099123 "Interior Painting." For example, HPC-01 shall match P-01, etc.

B. Exterior Color Selections:

	Surface	Color	Sheen
1.	Galvanized Metal Doors and Frames:	HPV-[**X**]	Semi-Gloss

C. Interior Color Selections:

	Surface	Color	Sheen
1.	Concrete Masonry Unit (CMU) Walls:	See Room Finish Schedule	Satin
2.	Exposed Structure (Locker Rooms):	CHPC-[**X**]	Eggshell

END OF SECTION 099600

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SECTION 101419 - DIMENSIONAL LETTER SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Dimensional characters.

a. Fabricated channel dimensional characters.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For signs.

1. Include fabrication and installation details and attachments to other work.
2. Show sign mounting heights, locations of supplementary supports to be provided by other installers, and accessories.
3. Show message list, typestyles, graphic elements, and layout for each sign at least half size.

C. Samples for Initial Selection: For each type of sign assembly, exposed component, and exposed finish.

1. Include representative Samples of available typestyles and graphic symbols.

D. Samples for Verification: For each type of sign assembly showing all components and with the required finish(es), in manufacturer's standard size unless otherwise indicated and as follows:

1. Dimensional Characters: Half-size Sample of each type of dimensional character.
2. Exposed Accessories: Half-size Sample of each accessory type.

E. Product Schedule: For dimensional letter signs. Use same designations indicated on Drawings or specified.

1.3 INFORMATIONAL SUBMITTALS

A. Sample Warranty: For special warranty.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For signs to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.6 FIELD CONDITIONS

A. Field Measurements: Verify locations of electrical service embedded in permanent construction by other installers by field measurements before fabrication, and indicate measurements on Shop Drawings.

1.7 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Deterioration of finishes beyond normal weathering.
b. Separation or delamination of sheet materials and components.

2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance: Signs and supporting elements shall withstand the effects of gravity and other loads within limits and under conditions indicated.

1. Uniform Wind Load: As indicated on Drawings.

B. Thermal Movements: For exterior fabricated channel dimensional characters, allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 DIMENSIONAL CHARACTERS

A. Fabricated Channel Characters (See Drawings): Metal face and side returns, formed free from warp and distortion; with uniform faces, sharp corners, and precisely formed lines and profiles; internally braced for stability, to meet structural performance loading without oil-canning or other surface deformation, and for securing fasteners; and as follows.

1. Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:<Double click here to find, evaluate, and insert list of manufacturers and products.>
   a. A.R.K. Ramos.
   b. ACE Sign Systems, Inc.
c. Signs & Decal Corp.
2. Character Material: Sheet or plate aluminum.
3. Material Thickness: Manufacturer's standard for size and design of character Nominal 0.048 inch thick for face and 0.030 inch thick for returns.
4. Character Height: As indicated on Drawings.
5. Character Depth: As indicated on Drawings.
6. Finishes:

   a. Integral Aluminum Finish: Anodized color as selected by Architect from full range of industry colors and color densities.

7. Mounting: Manufacturer's standard for size and design of character.

   a. Hold characters at manufacturer's recommended distance from wall surface.

8. Typeface: **Arial** .

2.3 DIMENSIONAL CHARACTER MATERIALS

A. Aluminum Sheet and Plate: ASTM B209, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.

B. Aluminum Extrusions: ASTM B221, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.

2.4 ACCESSORIES

A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signs, noncorrosive and compatible with each material joined, and complying with the following:

1. Use concealed fasteners and anchors unless indicated to be exposed.
2. For exterior exposure, furnish nonferrous-metal devices unless otherwise indicated.

2.5 FABRICATION

A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.

1. Preassemble signs and assemblies in the shop to greatest extent possible. Disassemble signs and assemblies only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation; apply markings in locations concealed from view after final assembly.

2. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.
3. Comply with AWS for recommended practices in welding and brazing. Provide welds and brazes behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded and brazed connections of flux, and dress exposed and contact surfaces.
4. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
5. Internally brace dimensional characters for stability, to meet structural performance loading without oil-canning or other surface deformation, and for securing fasteners.
6. Provide rabbets, lugs, and tabs necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match sign finish.

B. Brackets: Fabricate brackets, fittings, and hardware for bracket-mounted signs to suit sign construction and mounting conditions indicated. Modify manufacturer's standard brackets as required.

1. Aluminum Brackets: Factory finish brackets with baked-enamel or powder-coat finish to match sign-background color color unless otherwise indicated.

2.6 GENERAL FINISH REQUIREMENTS

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

C. Directional Finishes: Run grain with long dimension of each piece and perpendicular to long dimension of finished trim or border surface unless otherwise indicated.

D. Organic, Anodic, and Chemically Produced Finishes: Apply to formed metal after fabrication but before applying contrasting polished finishes on raised features unless otherwise indicated.

2.7 ALUMINUM FINISHES

A. Color Anodic Finish: AAMA 611, Class I, 0.018 mm or thicker.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Verify that sign-support surfaces are within tolerances to accommodate signs without gaps or irregularities between backs of signs and support surfaces unless otherwise indicated.

C. Verify that electrical service is correctly sized and located to accommodate signs.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF DIMENSIONAL CHARACTERS

A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.

1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
2. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.
3. Corrosion Protection: Coat concealed surfaces of exterior aluminum in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

B. Mounting Methods:

1. Concealed Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.

a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place sign in position and push until flush to surface, embedding studs in holes. Temporarily support sign in position until adhesive fully sets.
b. Thin or Hollow Surfaces: Place sign in position and flush to surface, install washers and nuts on studs projecting through opposite side of surface, and tighten.

3.3 ADJUSTING AND CLEANING

A. Remove and replace damaged or deformed characters and signs that do not comply with specified requirements. Replace characters with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.

B. Remove temporary protective coverings and strippable films as signs are installed.

C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions, and touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect from damage until acceptance by Owner.

END OF SECTION 101419

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SECTION 102113.17 - PHENOLIC-CORE TOILET COMPARTMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Phenolic-core toilet compartments.

B. Related Requirements:

1. Section 055000 "Metal Fabrications" for supports that attach floor-and-ceiling-anchored compartments to overhead structural system.
2. Section 061000 "Rough Carpentry" for blocking.
3. Section 092216 "Non-Structural Metal Framing" for blocking.
4. Section 102800 "Toilet, Bath, and Laundry Accessories" for accessories mounted on toilet compartments.

1.2 COORDINATION

A. Coordinate requirements for overhead supports, blocking, reinforcing, and other supports concealed within wall and ceiling to ensure that toilet compartments can be supported and installed as indicated.

1.3 ACTION SUBMITTALS

A. Product Data.

1. Phenolic-core toilet compartments.

a. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for toilet compartments.

B. Shop Drawings:

1. Include plans, elevations, sections, details, and attachment details.
2. Show locations of centerlines of toilet fixtures.
3. Show locations of floor drains.

C. Samples for Initial Selection: Manufacturer's standard color sheets, showing full range of available colors for each type of toilet compartment.

1. Include Samples of hardware and accessories involving material and color selection.

D. Samples for Verification: Actual sample of finished products for each type of toilet compartment, hardware, and accessory.

1. Size: Manufacturers' standard size.

E. Product Schedule: For toilet compartments, prepared by or under the supervision of supplier, detailing location and selected colors for toilet compartment material.

F. Delegated Design Submittals: For grab bars mounted on toilet compartment panels, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Include structural design calculations indicating compliance with specified structural-performance requirements.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For toilet compartments.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Extra Stock Materials: Furnish extra materials to Owner that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Door Hinges: One hinge(s) with associated fasteners.
2. Latch and Keeper: One latch(es) and keeper(s) with associated fasteners.
3. Door Bumper: One door bumper(s) with associated fasteners.
4. Door Pull: One door pull(s) with associated fasteners.
5. Fasteners: 10 fasteners of each size and type.

1.6 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of toilet fixtures, walls, columns, ceilings, and other construction contiguous with toilet compartments by field measurements, and coordinate before fabrication.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain phenolic-core toilet compartments from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 450 or less.

B. Structural Performance: Where grab bars are mounted on toilet compartments, design panels to comply with the following requirements:

1. Panels are able to withstand a concentrated load on grab bar of at least 250 lbf applied at any direction and at any point, without deformation of panel.

C. Regulatory Requirements: Comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design" Texas Accessibility Code and ICC A117.1 for toilet compartments designated as accessible.

2.3 PHENOLIC-CORE TOILET COMPARTMENTS: TC-01

A. Manufacturers: Basis of Design Accurate Partitions Corp, Alpaco Classic, Subject to compliance with requirements, provide products by one of the following;

1. Accurate Partitions Corp.; ASI Group
2. Bobrick Washroom Equipment Inc.
3. Ampco Products, LLC.
4. Columbia Lockers; Partitions Systems International of South Carolina
5. General Partitions Mfg. Corp.
6. Global Partitions Corp.
7. Scranton Products

B. Toilet-Enclosure Style: Floor anchored , privacy type.

C. Urinal-Screen Style: Wall hung.

D. Door, Panel, and Pilaster Construction: Solid phenolic-core material with glue laminate facing, and with eased and polished edges. Provide minimum 3/4-inch- thick doors and pilasters and minimum 3/4-inch- thick panels. Provide with no-sightline system consisting of door and pilaster lapped edges on strike side of door and door and pilaster lapped edges on hinge side of door (unless continuous hinge is used).

E. Entrance-Screen Construction: Matching panel construction.

F. Urinal-Screen Construction: Matching panel construction.

G. Pilaster Pegs: Brushed stainless steel adjustable in height plus or minus 1 inch (25 mm) to support panel 4 inches (102 mm) above finished floor..

H. Head Rail: Brushed stainless steel 1 ¼ inch (32 mm) diameter tube attached with clips to top of pilaster. .

I. Brackets (Fittings):

1. Full-Height (Continuous) Type: Manufacturer's standard design, stainless steel.

J. Phenolic Compartment Finish: One color in each room.

1. Color selection shall be based on laminate manufacturer’s standard colors and not on the standard colors of the phenolic materials..

a. Laminate Facing Sheet: As selected by Architect from laminate manufacturer.: .

2.4 HARDWARE AND ACCESSORIES

A. Door Hardware and Accessories: Manufacturer's operating hardware and accessories.

B. Door Hardware and Accessories, Heavy Duty: Manufacturer's heavy-duty institutional operating hardware and accessories.

1. Hinges: Manufacturer's minimum 0.062-inch- thick, stainless steel surface-mounted, paired, self-closing type that can be adjusted to hold doors open at any angle up to 90 degrees, allowing emergency access by lifting door. Mount with through bolts.
2. Coat Hook: Manufacturer's heavy-duty, combination cast stainless steel hook and rubber-tipped bumper, sized to prevent inswinging door from hitting compartment-mounted accessories. Mount with through bolts.
3. Door Bumper: Manufacturer's heavy-duty, rubber-tipped, cast stainless steel bumper at outswinging doors. Mount with through bolts.
4. Door Pull: Manufacturer's heavy-duty, cast stainless steel pull at outswinging doors that complies with regulatory requirements for accessibility. Provide units on both sides of doors at toilet enclosures designated as accessible. Mount with through bolts.

C. Overhead Bracing: Manufacturer's standard continuous, extruded-aluminum head rail with antigrip profile and in manufacturer's standard finish.

D. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel, finished to match items they are securing, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use stainless steel, hot-dip galvanized-steel, or other rust-resistant, protective-coated steel compatible with related materials.

2.5 MATERIALS

A. Aluminum Castings: ASTM B26/B26M.

B. Aluminum Extrusions: ASTM B221.

C. Stainless Steel Sheet: ASTM A240/A240M or ASTM A666, Type 304, stretcher-leveled standard of flatness.

D. Stainless Steel Castings: ASTM A743/A743M.

2.6 FABRICATION

A. Fabricate toilet compartment components to sizes indicated. Coordinate requirements and provide cutouts for through-partition toilet accessories where required for attachment of toilet accessories.

B. Overhead-Braced Units: Manufacturer's standard corrosion-resistant supports, leveling mechanism, and anchors at pilasters and walls to suit floor and wall conditions. Provide shoes at pilasters to conceal supports and leveling mechanism.

C. Floor-Anchored Units: Manufacturer's standard corrosion-resistant anchoring assemblies at pilasters and walls, with leveling adjustment nuts at pilasters for structural connection to floor. Provide shoes at pilasters to conceal anchorage.

D. Door Size and Swings: Unless otherwise indicated, provide 24-inch- wide, inswinging doors for standard toilet enclosures and 36-inch- wide, outswinging doors with a minimum 32-inch- wide, clear opening for toilet enclosures designated as accessible.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for fastening, support, alignment, operating clearances, and other conditions affecting performance of the Work.

1. Confirm location and adequacy of blocking and supports required for installation.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.

1. Maximum Clearances:

a. Pilasters and Panels or Screens: 1/2 inch.
b. Panels or Screens and Walls: 1 inch.

2. Stirrup Brackets: Secure panels or screens to walls and to pilasters with no fewer than three brackets attached at midpoint and near top and bottom of panel.

    a. Locate wall brackets so holes for wall anchors occur in masonry or tile joints.
    b. Align brackets at pilasters with brackets at walls.

3. Full-Height (Continuous) Brackets: Secure panels or screens to walls and to pilasters with full-height brackets.

    a. Locate bracket fasteners so holes for wall anchors occur in masonry or tile joints.
    b. Align brackets at pilasters with brackets at walls.

B. Overhead-Braced Units: Secure pilasters to floor and level, plumb, and tighten. Set pilasters with anchors penetrating not less than 1-3/4 inches into structural floor unless otherwise indicated in manufacturer's written instructions. Secure continuous head rail to each pilaster with no fewer than two fasteners. Hang doors to align tops of doors with tops of panels, and adjust so tops of doors are parallel with overhead brace when doors are in closed position.

C. Floor-Anchored Units: Set pilasters with anchors penetrating not less than 2 inches into structural floor unless otherwise indicated in manufacturer's written instructions. Level, plumb, and tighten pilasters. Hang doors and adjust so tops of doors are level with tops of pilasters when doors are in closed position.

D. Ceiling-Hung Units: Secure pilasters to supporting structure and level, plumb, and tighten. Hang doors and adjust so bottoms of doors are level with bottoms of pilasters when doors are in closed position.

E. Floor-and-Ceiling-Anchored Units: Secure pilasters to supporting construction and level, plumb, and tighten. Hang doors and adjust so doors are level and aligned with panels when doors are in closed position.

F. Urinal Screens: Attach with anchoring devices to suit supporting structure. Set units level and plumb, rigid, and secured to resist lateral impact.

3.3 ADJUSTING

A. Hardware Adjustment: Adjust and lubricate hardware in accordance with hardware manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors to return doors to fully closed position.

END OF SECTION 102113.17

SECTION 102800 - TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Public-use washroom accessories.
2. Childcare accessories.
3. Custodial accessories.

B. Related Requirements:

1. Section 61000 – Rough Carpentry for wood blocking.
2. Section 092216 – Non-Structural Metal Framing” for metal plate anchorage.

1.3 COORDINATION

A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.

B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Include anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
3. Include electrical characteristics.

B. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.

1. Identify locations using room designations indicated.

2. Identify accessories using designations indicated.

C. Delegated Design Submittals: For Grab Bars.

1. Include structural design calculations indicating compliance with specified structural performance requirements.

1.5 INFORMATIONAL SUBMITTALS

A. Sample Warranty: For manufacturer's special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For accessories to include in maintenance manuals.

1.7 WARRANTY

A. Manufacturer's Special Warranty for Mirrors: Manufacturer agrees to repair or replace mirrors that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, visible silver spoilage defects.
2. Warranty Period: 10 years from date of Substantial Completion.

B. Manufacturer’s Special Warranty for Toilet-Compartment Occupancy-Indicator Systems: Manufacturer agrees to repair or replace toilet-compartment occupancy-indicator systems that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five (5) years from the date of Substantial Completion.

C. Manufacturer’s Special Warranty for Electric Hand Dyers: 2 years.

PART 2 - PRODUCTS

2.1 OWNER-FURNISHED MATERIALS

1. Hand Towel Dispensers.
2. Soap Dispensers.

2.2 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Structural Performance: Design accessories and fasteners to comply with the following requirements:

1. Grab Bars: Installed units are able to resist 250 lbf concentrated load applied in any direction and at any point.

2.3 PUBLIC-USE WASHROOM ACCESSORIES

A. Source Limitations: Obtain public-use washroom accessories from single source from single manufacturer.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. A & J Washroom Accessories, Inc.
2. American Specialties, Inc.
3. Bobrick Washroom Equipment, Inc.
4. Bradley Corporation.
5. GAMCO Specialty Accessories; a division of Bobrick Washroom Equipment, Inc.
6. Royce Rolls Ringer Company.
7. Tubular Specialties Manufacturing, Inc.

C. Toilet Tissue (Roll) Dispenser (TTD):

1. Basis-of-Design Product: As indicated in the Toilet and Bath Accessory Schedule at the end of Part 3.
2. Description: Double-roll dispenser with hoods.
3. Mounting: Surface mounted.
4. Operation: Noncontrol delivery with theft-resistant spindle.
5. Capacity: Designed for **4-1/2- or 5-inch-** diameter tissue rolls.
6. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin) .

D. Grab Bar (GB-1, GB-2, GB-3:

1. Basis-of-Design Product: As indicated in the Toilet and Bath Accessory Schedule at the end of Part 3.
2. Mounting: Flanges with concealed fasteners.
3. Material: Stainless steel, 0.05 inch thick.

    a. Finish: Smooth, ASTM A480/A480M No. 4 finish (satin) on ends and slip-resistant texture in grip area.

4. Outside Diameter: 1-1/2 inches.
5. Configuration and Length: As indicated by manufacturer’s designations in the Toilet and Bath Accessory Schedule at the end of Part 3.

E. Sanitary-Napkin Disposal Unit (SND):

1. Basis-of-Design Product: As indicated in the Toilet and Bath Accessory Schedule at the end of Part 3.
2. Mounting: Surface mounted.

3. Door or Cover: Self-closing, disposal-opening cover and hinged face panel with tumbler lockset.
4. Receptacle: Removable.
5. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).

F. Mirror Unit (MR:

1. Basis-of-Design Product: As indicated in the Toilet and Bath Accessory Schedule at the end of Part 3
2. Frame: Stainless steel angle, 0.05 inch thick.

    a. Corners: Welded and ground smooth.

3. Hangers: Produce rigid, tamper- and theft-resistant installation, using method indicated below.

    a. Wall bracket of galvanized steel, equipped with concealed locking devices requiring a special tool to remove.

4. Size: As indicated in the Toilet and Bath Accessory Schedule at the end of Part 3..

2.4 WARM-AIR DRYERS

A. Source Limitations: Owner Furnished Contractor Installed.

2.5 CHILDCARE / ADULTCARE ACCESSORIES

A. Baby-Changing Station (BCS):

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. American Specialties, Inc.
    b. Brocar Products, Inc.
    c. Diaper Deck & Company, Inc.
    d. GAMCO Specialty Accessories; a division of Bobrick Washroom Equipment, Inc.
    e. Koala Kare Products; a division of Bobrick Washroom Equipment, Inc.
    f. SSC, Inc.
    g. Tubular Specialties Manufacturing, Inc.

2. Basis-of-Design Product: As indicated in the Toilet and Bath Accessory Schedule at the end of Part 3.
3. Description: Horizontal unit that opens by folding down from stored position and with child-protection strap.

a. Engineered to support minimum of 250-lb static load when opened.

4. Mounting: Surface mounted, with unit projecting not more than 4 inches from wall when closed.
5. Operation: By pneumatic shock-absorbing mechanism.
6. Material and Finish: HDPE in manufacturer's standard color with antimicrobial additive embedded in the bed surface.
7. Liner Dispenser: Built in.

2.6 CUSTODIAL ACCESSORIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. A & J Washroom Accessories, Inc.
2. American Specialties, Inc.
3. Bobrick Washroom Equipment, Inc.
4. Bradley Corporation.
5. GAMCO Specialty Accessories; a division of Bobrick Washroom Equipment, Inc.
6. Tubular Specialties Manufacturing, Inc.

B. Source Limitations: Obtain custodial accessories from single source from single manufacturer.

C. Utility Shelf -Mop and Broom Holder (US):

1. Basis-of-Design Product: As indicated in the Toilet and Bath Accessory Schedule at the end of Part 3.
2. Description: Unit with shelf, hooks and holders.
3. Length: 44 inches.
4. Hooks: Five.
5. Mop/Broom Holders: Four, spring-loaded, rubber hat, cam type.
6. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).

a. Shelf: Not less than nominal 0.05-inch- thick stainless steel.

2.7 MATERIALS

A. Stainless Steel: ASTM A240/A240M or ASTM A666, Type 304, 0.031-inch minimum nominal thickness unless otherwise indicated.

B. Steel Sheet: ASTM A1008/A1008M, Designation CS (cold rolled, commercial steel), 0.036-inch minimum nominal thickness.

C. Galvanized-Steel Sheet: ASTM A653/A653M, with G60 hot-dip zinc coating.

D. Galvanized-Steel Mounting Devices: ASTM A153/A153M, hot-dip galvanized after fabrication.

E. Fasteners: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant where exposed, and of galvanized steel where concealed.

F. Chrome Plating: ASTM B456, Service Condition Number SC 2 (moderate service).

G. Mirrors: ASTM C1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.

2.8 FABRICATION

A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.

B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.

B. Grab Bars: Install to withstand a downward load of at least 250 lbf, when tested according to ASTM F446.

3.2 ADJUSTING AND CLEANING

A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.

B. Remove temporary labels and protective coatings.

C. Clean and polish exposed surfaces according to manufacturer's written instructions.

3.3 TOILET ACCESSORY SCHEDULE

A. See Large Scale Plan Drawing for mounting heights.

PLAN SYMBOL	DESCRIPTION	MANUFACTURER BOBRICK (unless noted otherwise)
BCS	Baby Changing Station	KB200 (Koala Kare Products)
EHD	Electric Hand Dryer	Owner Furnished Contractor Installed
GB-1	Grab Bar (back wall)	B-6806 x 36”
GB-2	Grab Bar (side wall)	B-6806 x 42"
GB-3	Grab Bar (vertical)	B-6806 x 18"
MR	Mirror	B-290 2436
PTD	Paper Towel Dispenser - Owner Furnished Contractor Installed	
SD	Soap Dispenser - Owner Furnished Contractor Installed	
SND	Sanitary Napkin Disposal	B-270
TTD	Toilet Tissue Dispenser	Royce Rolls #CTP-2 (No Substitutions)

END OF SECTION 102800

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SECTION 104413 - FIRE PROTECTION CABINETS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fire-protection cabinets for the following:

a. Portable fire extinguisher.

B. Related Requirements:

1. Section 104416 "Fire Extinguishers" for portable, hand-carried fire extinguishers accommodated by fire-protection cabinets.
2. Section 211000 "Water-Based Fire-Suppression Systems" for fire-hose connections.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Show door hardware, cabinet type, trim style, and panel style. Include roughing-in dimensions and details showing recessed-, semirecessed-, or surface-mounting method and relationships of box and trim to surrounding construction.
2. Show location of knockouts for hose valves.

B. Shop Drawings: For fire-protection cabinets.

1. Include plans, elevations, sections, details, and attachments to other work.

C. Product Schedule: For fire-protection cabinets. Indicate whether recessed, semirecessed, or surface mounted. Coordinate final fire-protection cabinet schedule with fire-extinguisher schedule to ensure proper fit and function.[**Use same designations indicated on Drawings.**]

1.3 CLOSEOUT SUBMITTALS

A. Maintenance Data: For fire-protection cabinets to include in maintenance manuals.

1.4 COORDINATION

A. Coordinate size of fire-protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.

B. Coordinate sizes and locations of fire-protection cabinets with wall depths.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain fire-protection cabinets, accessories, and fire extinguishers from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Fire-Rated Fire-Protection Cabinets: Listed and labeled to comply with requirements in ASTM E814 for fire-resistance rating of walls where they are installed.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.3 FIRE-PROTECTION CABINET FEC

A. Fire-Protection Cabinet Type: Suitable for fire extinguisher.

1. Basis-of-Design Product: Subject to compliance with requirements, provide J. L. Industries, Inc.; Activar Construction Products Group, Inc.; Ambassador Series Fire Protection Cabinet or a comparable product by one of the following:

a. Croker; a Division of Morris Group International.
b. Larsen's Manufacturing Company.
c. MOON American, Inc.
d. Modern Metal Products.
e. Potter Roemer LLC; a Division of Morris Group International.

B. Cabinet Construction: Nonrated One-hour fire rated Two-hour fire rated to match adjacent construction.

1. Fire-Rated Cabinets: Construct fire-rated cabinets with double walls fabricated from 0.043-inch- thick cold-rolled steel sheet lined with minimum 5/8-inch- thick fire-barrier material. Provide factory-drilled mounting holes.

C. Cabinet Material: Cold-rolled steel sheet.

1. Shelf: Same metal and finish as cabinet.

D. Semirecessed Cabinet: One-piece combination trim and perimeter door frame overlapping surrounding wall surface, with exposed trim face and wall return at outer edge (backbend).

1. Rolled-Edge Trim: 2-1/2-inch backbend depth.

E. Cabinet Trim Material: Steel sheet.

F. Door Material: Steel sheet.

G. Door Style: Solid opaque panel with frame.

H. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.

1. Provide projecting lever handle with cam-action latch.
2. Provide continuous hinge, of same material and finish as trim,, permitting door to open 180 degrees.

I. Accessories:

1. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to fire-protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
2. Lettered Door Handle: One-piece, cast-iron door handle with the word "FIRE" embossed into face.
3. Door Lock: Cam lock that allows door to be opened during emergency by pulling sharply on door handle.
4. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as directed by Architect.

a. Identify fire extinguisher in fire-protection cabinet with the words "FIRE EXTINGUISHER."

1) Location: Applied to cabinet door.
2) Application Process: Silk-screened.
3) Lettering Color: Red.
4) Orientation: Vertical.

J. Materials:

1. Cold-Rolled Steel: ASTM A1008/A1008M, Commercial Steel (CS), Type B.

a. Finish: Baked enamel, TGIC polyester powder coat, HAA polyester powder coat, epoxy powder coat, or polyester/epoxy hybrid powder coat, complying with AAMA 2603.
b. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
c. Color: White.

2.4 FABRICATION

A. Fire-Protection Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.

1. Weld joints and grind smooth.
2. Miter corners and grind smooth.

3. Provide factory-drilled mounting holes.
4. Prepare doors and frames to receive locks.
5. Install door locks at factory.

B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles.

1. Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum 1/2 inch thick.
2. Fabricate door frames of one-piece construction with edges flanged.
3. Miter and weld perimeter door frames and grind smooth.

C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

2.5 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's AMP 500, "Metal Finishes Manual for Architectural and Metal Products," for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces of fire-protection cabinets from damage by applying a strippable, temporary protective covering before shipping.

C. Finish fire-protection cabinets after assembly.

D. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls and partitions for suitable framing depth and blocking where semirecessed cabinets will be installed.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare recesses for semirecessed fire-protection cabinets as required by type and size of cabinet and trim style.

3.3 INSTALLATION OF FIRE-PROTECTION CABINETS

A. General: Install fire-protection cabinets in locations and at mounting heights indicated or, if not indicated, at heights acceptable to authorities having jurisdiction.

1. Fire-Protection Cabinet Mounting Height: 42 inches above finished floor to top of fire extinguisher.

B. Fire-Protection Cabinets: Fasten cabinets to structure, square and plumb.

1. Unless otherwise indicated, provide recessed fire-protection cabinets. If wall thickness is inadequate for recessed cabinets, provide semirecessed fire-protection cabinets.
2. Provide inside latch and lock for break-glass panels.
3. Fasten mounting brackets to inside surface of fire-protection cabinets, square and plumb.

3.4 ADJUSTING AND CLEANING

A. Remove temporary protective coverings and strippable films, if any, as fire-protection cabinets are installed unless otherwise indicated in manufacturer's written installation instructions.

B. Adjust fire-protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.

C. On completion of fire-protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.

D. Touch up marred finishes, or replace fire-protection cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by fire-protection cabinet and mounting bracket manufacturers.

E. Replace fire-protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 104413

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SECTION 104416 - FIRE EXTINGUISHERS

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 portable, hand-carried fire extinguishers and mounting brackets for fire extinguishers.

B. Related Requirements:

1. Section 104413 "Fire Protection Cabinets."

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. Include rating and classification, material descriptions, dimensions of individual components and profiles, and finishes for fire extinguisher and mounting brackets.

1.4 INFORMATIONAL SUBMITTALS

A. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fire extinguishers to include in maintenance manuals.

1.6 COORDINATION

A. Coordinate type and capacity of fire extinguishers with fire-protection cabinets to ensure fit and function.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

    a. Failure of hydrostatic test according to NFPA 10 when testing interval required by NFPA 10 is within the warranty period.
    b. Faulty operation of valves or release levers.

2. Warranty Period: Six years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."

B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

2.2 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

A. Fire Extinguishers: Type, size, and capacity for each fire-protection cabinet and mounting bracket indicated.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Amerex Corporation.
    b. Ansul Incorporated; Tyco International.
    c. Badger Fire Protection.
    d. Buckeye Fire Equipment Company.
    e. Fire End & Croker Corporation.
    f. Guardian Fire Equipment, Inc.
    g. JL Industries, Inc.; a division of the Activar Construction Products Group.
    h. Kidde Residential and Commercial Division.
    i. Larsens Manufacturing Company.
    j. MOON American.
    k. Pem All Fire Extinguisher Corp.; Pem Systems, Inc.
    l. Potter Roemer LLC.
    m. Pyro-Chem; Tyco Fire Suppression & Building Products.

2. Source Limitations: Obtain fire extinguishers, fire-protection cabinets, and accessories, from single source from single manufacturer.
3. Valves: Manufacturer's standard.
4. Handles and Levers: Manufacturer's standard.
5. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B.

B. Wet-Chemical Type (Class K at FE/K and FEC/K designations on Floor Plans):: UL-rated 2-A:1-B:C:K, 2.5-gal. nominal capacity, with potassium acetate-based chemical in stainless-steel container; with pressure-indicating gage.

C. Multipurpose Dry-Chemical Type in Steel Container (, FEC): UL-rated 4-A:60-B:C, 10-lb nominal capacity, with monoammonium phosphate-based dry chemical in enameled-steel container.

2.3 MOUNTING BRACKETS (FE and FE/K)

A. Mounting Brackets: Manufacturer's standard steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or red baked-enamel finish.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Amerex Corporation.
b. Ansul Incorporated; Tyco International.
c. Badger Fire Protection.
d. Buckeye Fire Equipment Company.
e. Fire End & Croker Corporation.
f. JL Industries, Inc.; a division of the Activar Construction Products Group.
g. Larsens Manufacturing Company.
h. Potter Roemer LLC.

2. Source Limitations: Obtain mounting brackets and fire extinguishers from single source from single manufacturer.

B. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Architect.

1. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.

a. Orientation: Vertical.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine fire extinguishers for proper charging and tagging.

1. Remove and replace damaged, defective, or undercharged fire extinguishers.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install fire extinguishers and mounting brackets in locations indicated and in compliance with requirements of authorities having jurisdiction.

1. Mounting Brackets: Top of fire extinguisher to be at 54 inches above finished floor.

B. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

END OF SECTION 104416

SECTION 107080 - SUNSHADES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fixed custom sunshades.

B. Related Requirements:

1. Section 055000 "Metal Fabrication."

1.2 ACTION SUBMITTALS

A. Product Data:

1. Submit manufacturer's specifications, data, and installation instructions.

B. Shop Drawings:

1. Include elevations, sections, and specific details for each sunshade.
2. Show anchorage details and connections for all component parts.
3. Include Delegated Design signed and sealed structural calculations.

C. Samples:

1. Samples for Initial Selection: Submit color chips for approval.

D. Product Schedule: For sunshades. Use same designations indicated on Drawings.

1.3 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Sample Warranty: For special warranty.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For sunshades to include in operation and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Manufacturer 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 and not less than ten years' experience in the design and manufacturing of sunshades. For quality and delivery control, sunshade system must be purchased from a single source manufacturer. Sub-contracting of sunshade assembly is not acceptable.

B. Installer Qualifications: Fabricator of products.

C. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."

D. Performance:

1. Delegated Design: Design sunshades to accommodate local requirements for snow and wind loading. Provide engineering calculations to support design. Analysis to include all components of sunshade including but not limited to deflection of blades, outriggers and fascia. Deflection to be limited to L/120, 3/4-inch, or as required by code.
2. Professional Engineer Requirements: Drawings and structural calculations to be signed and sealed by a professional engineer licensed to practice in the project state.

1.6 DELIVERY, STORAGE AND HANDLING

A. Delivery: At the time of delivery all materials shall be visually inspected for damage. Any damaged boxes, crates, louver sections, etc. shall be noted on the receiving ticket and immediately reported to the shipping company and the material manufacturer.

B. Storage:

1. Material may be stored flat on end or on its side.
2. Material may be stored either indoors or outdoors.
3. If stored outdoors the material must be raised sufficiently off the ground to prevent it being flooded.
4. If stored outdoors the material must be covered with a weatherproof flame-resistant sheeting or tarpaulin.

C. Handling: Material shall be handled in accordance with sound material handling practices and in such a way as to minimize racking

1.7 WARRANTY

A. Special Warranty: Manufacturer and fabricator agree to repair or replace components of awnings that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including framework.
b. Deterioration of metals, metal finishes, and other materials beyond normal weathering.

2. Warranty Period: One year from date of Substantial Completion.
3. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide products by AVAdek Walkway Cover Systems & Canopies; Perform Sunshades or comparable product by one of the following:

1. American Metalcraft, Inc., Villa Rica, Georgia.
2. Architectural Shade Products, Ball Ground, GA.
3. Industrial Louvres, Inc, Delano, MN.
4. Mapei Architectural Canopies

B. Drawings and specifications are based on manufacturer’s literature from AVAdek Walkway Cover Systems & Canopies unless otherwise indicated. Other manufacturers must be approved equal by Architect/Owner

2.3 MATERIALS

A. Aluminum Extrusions: ASTM B211, Alloy 6063-T5, 6063-T6 or 6061-T6.

B. Fasteners: Fasteners to be aluminum or stainless steel. Provide types, gauges and lengths engineered to suit installation conditions by manufacturer or supplier. All fasteners to the structure are to be designed by a Professional Engineer licensed to practice in the project state and supplied by the manufacturer

C. Anchors and Inserts: Use non-ferrous metal or hot dip galvanized anchors and inserts for installation and elsewhere as required for corrosion resistance. Use stainless steel or lead expansion bolt devices for drill in place anchors. Furnish inserts, as required, to be set into concrete or masonry work.

2.4 FABRICATION, GENERAL

A. Provide AVAdek fixed sunshades and accessories materials, sizes, depths, arrangements, and material thickness to be as indicated or as required for optimal performance with respect to strength; durability; and uniform appearance.

B. Include supports, anchorage, and accessories required for complete assembly.

2.5 SUNSHADE MODELS

A. Sunshade System:

1. Outriggers: Outriggers AVAdek custom profile flat aluminum plate members with front edge cut to match support fascia profiles exactly.
2. System to be supplied with a 2 ¾” aluminum corrugated decking.
3. Fascia: 8” Aluminum extruded trim .
4. Hanger Rods: 1.9” OD Pipe Brace, Hanger Rood and attachment hardware shall be powder coated to match canopy
5. Mounting Bracket: Aluminum mounting bracket by sunshade manufacturer. All fasteners mounting to structure to be designed and supplied by sunshade manufacturer. Fasteners to be stainless steel 300 series.

2.6 FINISHES

A. General: Comply with NAAMM "Metal Finishes Manual" for finish designations and application recommendations, except as otherwise indicated. Apply finishes in factory. Protect finishes on exposed surfaces prior to shipment. Remove scratches and blemishes from exposed surfaces that will be visible after completing finishing process. Provide color as indicated or, if not otherwise indicated, as selected by Architect.

B. 100% Fluoropolymer Resin Powder Coat System complying with AAMA-2605-5 standards for gloss and color retention. Finish thickness to be 1.5 to 3.0 mils.

1. Finish to allow zero VOCs to be emitted into facility of application or at job site.
2. Finish to adhere to a 4H Hardness rating.
3. Furnish manufacturer's 20-year warranty for finish for gloss and color retention

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine openings to receive the work. Do not proceed until any unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with manufacturer's instructions and recommendations for installation of the work.

B. Verify dimensions of supporting structure at the site by accurate field measurements so that the work will be accurately designed, fabricated, and fitted to the structure.

C. Anchor sunshades to the building substructure as indicated on architectural drawings.

D. Erection Tolerances:

1. Maximum variation from plane or location shown on the approved shop drawings: 1/8-inch per 12 feet of length, but not exceeding 1/2-inch in any total building length or portion thereof (non-cumulative).
2. Maximum offset from true alignment between two members abutting end to end, edge-to-edge in line or separated by less than 3-inch: 1/16-inch (shop or field joints). This limiting condition shall prevail under both load and no-load conditions.

E. Cut and trim component parts during erection only with the approval of the manufacturer or fabricator, and in accordance with his recommendations. Restore finish completely. Remove and replace members where cutting and trimming has impaired the strength or appearance of the assembly.

F. Do not erect warped, bowed, deformed, or otherwise damaged or defaced members. Remove and replace any members damaged in the erection process as directed.

G. Set units level, plumb and true to line, with uniform joints.

3.3 PROTECTION

A. Protect installed materials to prevent damage by other trades. Use materials that may be easily removed without leaving residue or permanent stains.

3.4 ADJUSTING AND CLEANING

A. Immediately clean exposed surfaces of the louvers to remove fingerprints and dirt accumulation during the installation process. Do not let soiling remain until the final cleaning.

B. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to the material finishes. Thoroughly rinse surfaces and dry.

C. Restore components damaged during installation and construction so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by the Architect, remove damaged materials, and replace with new materials.

1. Touch up minor abrasions in finishes with a compatible air-dried coating that matches the color and gloss of the factory applied coating.

END OF SECTION 107080

SECTION 107113 – EXTERIOR SHADE CANOPIES

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 WORK INCLUDED

A. Provision, fabrication and installation of Extruded Aluminum Shade Canopies, as shown on Drawings and specified herein, and as needed for a complete and proper installation.

1. Shade canopy.

1.3 RELATED WORK

A. Section 076200 “Sheet Metal Flashing and Trim.”

B. Section 079000 “Joint Sealants.”

C. Section 033000 “Cast-In-Place Concrete.”

D. Section 051200 “Structural Steel.”

1.4 REFERENCE STANDARDS

A. The Aluminum Association – Aluminum Design Manual 2010.

B. American Welding Society- AWS D1.2/D1.2M: 2008.

C. ASTM B 209 Aluminum & Aluminum Alloy Sheet and Plate.

D. ASTM B 221 Aluminum & Aluminum Ally Extruded Bars, Rods, Wire, Shapes, and Tubes.

1.5 SAMPLES

A. Submit samples in accordance with the requirements of Division 01 Sections.

B. Product Data: Manufacturer’s brochures, manuals, and literature.

C. Shop Drawings:

1. Includes the complete layout, sections, details, components, finishes, sizing, spacing, and fasteners specific to the project. The site-specific Delegated Design shop drawings for the shade canopies shall show reactions at surface attachment points and bear the seal of a Registered Structural Engineer in Texas.
2. Contractor shall submit shop drawings for approval by the Architect prior to fabrication of any materials.
3. Contractor to verify all dimensions and elevations prior to submittal to Architect.
4. Manufacturer/Contractor shall field verify dimensions prior to fabrication.

D. Delegated Design Criteria:

1. Meet or exceed 2015 IBC Ultimate requirements at 20 PSF live load.
2. Design for 133 MPH wind load.
3. Exposure C/Risk Category III with 6 PSF snow load.
4. Coordinate with Structural Drawings for concrete footings and reactions at column bases.

E. Finishes: Samples of canopy finishes.

1.6 QUALITY ASSURANCE

A. Canopy shall be designed to comply with state and local building codes.

B. Canopy manufacturer shall have a minimum of 10 years' experience in designing and installing the specified system.

C. The installation of the canopy shall be performed by the manufacturer to assure single source responsibility.

1.7 MATERIALS

A. Delivery, Storage, and Handling: protect components from one another during shipping, storage and handling. Exercise care when unloading, storing, and erecting to prevent damage.

1.8 WARRANTY

A. Provide manufacturer's 5-year warranty against defects in material and workmanship.

PART 2 - PRODUCTS

1. and Structural Loads:

a. Meet or exceed 2015 IBC Ultimate requirements at 20 PSF live load.
b. Design for 134 MPH wind load.
c. Exposure C/Risk Category III with 5 PSF snow load.

d. Coordinate with Structural Drawings for concrete footings and reactions at column bases.

2.2 SHADE CANOPY

A. Manufacturer: Subject to compliance with requirements, provide products by the following:

1. Basis-of-Design Manufacturer: AVAdek Walkway Cover Systems & Canopies; 12130 Galveston Road, Building 1; Webster, Texas 77598-1539; (713) 944-0988 or (800) 777-4031.
2. Other approved manufacturer's according to requirements in Section 002600 "Procurement Substitution Procedures."

B. Walkway Covers:

1. Extruded Aluminum Walkway Cover shall consist entirely of extruded aluminum sections (roll formed not acceptable). System shall consist of heli-arc welded, one-piece rigid structural bents (column and beam assemblies), decking, fascia, accessory items and hardware to provide a complete system.

a. Configuration: As indicated on drawings.
b. Sizes: as indicated on drawings.
c. Design Criteria: Design and fabricate to resist loads without failure, damage, or permanent deflection as dictated by the applicable building code. Structure shall be capable of sustaining and supporting a concentrated load such as being walked upon.
1. For welded material, the tensile ultimate strength, "Ftuw", and tensile yield strength, "Ftyw", shall be used to determine available strength within weld-affected zone.
2. Design, fabrication, and erection of aluminum load-carrying structures, members, and connections shall be in accordance with AA ADM – Aluminum Design Manual; As referenced in the International Building Code.
d. Soffit Finish: Woodgrain: AAMA 2604 – Super Polyester Powder Coated: Per ColorSchedule.
e. Canopy Finish: Class1 Color Anodized Finish: AAMA 611 AA-M12C22A44 Electrolytically deposited colored anodic coating not less than 0.7 mils thick.
f. Provide a complete system ready for erection at project site.
g. Shop-fabricate to the greatest extent possible; disassemble if necessary for shipping.

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2.3 MATERIALS

A. Components: All shade canopies components shall be 6063, 6061, or 6005 alloy extruded aluminum.

1. Aluminum Extrusions: ASTM B209 or B 221.
2. Aluminum Coated Steel Sheet: ASTM A792/A792M.

3. Concealed Structural Supports: Aluminum, or steel coated for corrosion resistance and dissimilar metal isolation.
4. Fasteners: ASTM F593 stainless steel or ASTM A 307 carbon steel.

    a. Deck Screws (rivets not permitted): Type 18-8 non-magnetic stainless steel sealed with a neoprene “O” ring beneath 5/8” outside dimension, conical washer.
    b. Fascia Rivets: Size 3/16” by 1/2” grip range aluminum rivets with aluminum mandrel.
    c. Bolts: All bolts, nuts and washers to be 18-8 non-magnetic stainless steel.
    d. Tek Screws: not permitted.

2.4 COMPONENTS

A. Configuration: As shown on the Drawings.

B. Sizes: Minimum sizing as shown on the Drawings.

C. Columns: All columns shall have radius corners.

D. Shading Components: Thickness shall be at least 0.078 inch.

E. Aluminum Flashing: Flashing thickness shall be at least 0.040 inch.

2.5 FASTENERS, CONNECTIONS, AND FITTINGS

A. Bolted Connections: All bolts, nuts, washers, and screws used in joining the members shall be stainless steel up to 3/8-inch diameter. Over 3/8-inch diameter may be hot dipped galvanized.

B. Contractor shall provide structural attachment points flush with the outside surface of the building.

C. Rafters shall be heliarc welded to posts and mounting plate system.

D. Beams shall be fastened to rafters with concealed clips.

E. Blades are mechanically fastened to structure with stainless steel screws, concealed where possible.

2.6 FINISHES

A. Canopy: Fluropon 70% PVDF: AAMA 2605-17 fluoropolymer 3-coat system (10 year finish warranty)

1. Color: As selected by Architect from manufacturer’s full range.

PART 3 - EXECUTION

3.1 INSTALLATION

A. The components and accessories are to be supplied and installed by the manufacturer.

B. Install canopy in strict accordance to manufacturer’s recommendations.

C. Erect canopy after concrete and masonry work in the vicinity is completed and washed down.

3.2 WORKMANSHIP

A. Take extreme care to prevent damage or scratching. Replace damaged components prior to installation. All workmanship must be top quality with meat miters and fitted joints.

3.3 CLEANING

A. Just prior to completion of project, strip protective coatings of covering from aluminum and clean all parts. Repair to new condition to replace any materials damaged during installation.

END OF SECTION 107113

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SECTION 116640 - GYMNASIUM SCOREBOARDS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Single-sided LED basketball scoreboards and shot clocks.

B. Related Requirements:

1. Section 116623 “Gymnasium Equipment” for shot clock support brackets for basketball backstops.

C. References:

1. Standard for Electric Signs, UL-48, 13th Edition.
2. Standard for Control Centers for Changing Message Type Signs, UL-1433, 1st Edition.
3. Standard for CAN/CSA C22.2 No. 207-M89 for indoor use.
4. Federal Communications Commission Regulation Part 15.
5. National Electric Code.

1.2 ACTION SUBMITTALS

A. Product data: Submit manufacturer’s product illustrations, data and literature that fully describe the scoreboards and accessories proposed for installation.

B. Shop drawings: Submit mechanical and electrical product specification drawings.

1.3 CLOSEOUT SUBMITTALS

A. Maintenance data: Submit manufacturer’s installation, operation, and maintenance manuals.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Product to be delivered to site.

B. Scoreboard and equipment to be housed in a clean, dry environment.

1.5 PROJECT CONDITIONS

A. Environmental Limitations: Do not install scoring equipment until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at the levels indicated for project when occupied for its intended use.

B. Field Measurements: Coordinate scoreboard location and height with the customer. Verify dimensions by field measurements.

1.6 QUALITY ASSURANCE

A. Scoreboard for indoor use only.

B. Source Limitations: Obtain each type of scoring equipment through one source from a single manufacturer.

C. Scoreboard to be ETL listed to UL Standards 48 and 1433, NEC compliant, FCC compliant and ETLC listed to CAN/CSA 22.2.

D. Equipment to be solid-state electronic technology.

1.7 WARRANTY/SERVICE PLAN

A. Provide five (5) year manufacturer’s standard warranty.

B. Provide an exchange program to supply replacement parts for components that fail during the coverage period. To minimize downtime, the exchange parts shall be shipped on the same day the order is received or on the following day. The manufacturer will also enclose an air bill for return of the defective components.

C. Provide access to a local Authorized Service Company.

D. There shall be a manufacturer owned sales and service office located within 60 miles (96.56 km) of the project site.

E. Provide a help desk staffed by experienced technicians and coordinators who are thoroughly familiar with the scoreboard and available for technical support. This staff must be available at no additional cost to the customer and provide an "on-call" service during weekends.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Spectrum, by Watchfire Corporation, 10050 Easthaven TX, 77075. (866)-254-6488.

2.2 GYMNASIUM SCOREBOARDS

A. Basis-of-Design Product: Spectrum Model 5230-UL4.

1. General: Single-sided basketball scoreboard shall be equipped also to score volleyball and wrestling. Independent and/or tandem operation.
2. Scoreboard Display: Period time to 99:59, HOME and GUEST scores to 199, PERIOD to nine, and indicates possession bonus, and double bonus. Electronic captions change when volleyball and wrestling modes are selected. When period time is less than one minute, the scoreboards displays time to 1/10 of a second.

B. Scoreboard General Information:

1. Dimensions: 3 feet high by 10 feet wide by 5 inches deep.
2. Hanging Weight: lbs.
3. Power Requirement: 480 W consumption. 20-amp, 120-volt, 60-hertz, grounded AC circuit connected to an ON/OFF switch or circuit breaker.
4. Color: As selected by the Architect from manufacturer's full range.
5. Provide an electronic standard horn rated at 100 dB @ 10'-0".

C. Scoreboard Construction:

1. Cabinet shall be constructed of 22 gauge steel.
2. Scoreboard back, face, and perimeter: 0.063-inch (1.60 mm) thick.
3. Finish in Two-Component Polyurethane coating..
4. Captions shall be adhesive backed vinyl permanently attached to the cabinet and "Home" and "Visitor" shall be 6 inches in height; Period shall be 3 inches in height.
5. Electronics to be packed in a low voltage plug-in processor accessible from the cabinet front.

D. Digits and Indicators:

1. Display digits shall be made up of eight segments and contain sixteen (16) SpectraLite LEDs per pixel. SpectraLite LED Digits shall be colored Red for Clock, Bonus and Double Bonus; and colored Amber for Team Score, Home and Visitor Possession Indicator and Period..
2. Digital height to be 14 inches for Clock and Team Score; and 10 inches for Period. Clock shall have a display capacity up to to "99:95"; team scores to 199; and period to "9". Bonus shall be indicated by "B"; Double Bonus by "B B"; and Possession Indicators by arrows for each team..
3. All LED Digits are covered with 1/8 inch Lexan SpectraSheilds to protect and absorb impacts..
4. All pixels are rated at least 100,000 hours of use..
5. Display configuration shall be 4 x 7 for 14 inches; 3 x 5for 10 inches.
6. Digits shall consist of the following number of pixels: 14 inches, 20 pixels; 10 inches, 13 pixels (16 LEDs per pixel).
7. LED Digit Brightness: 40,000 MCD (millicandela).

E. Power Cord:

1. Cord: 11 feet long.
2. Cord plugs into a standard grounded outlet.

2.3 SCORING CONSOLE

A. Basis-of-Design Product: Spectrum Model MSXcontroller.

1. Scores multiple sports using changeable keyboard inserts.
2. Includes a changeable color coded keypad to allow key identification change to operate multiple scoreboards. Electronic features shall include a program mode allowing change in sport controlled or accommodation of a sport rules change and a memory circuit to retain information if power is interrupted..
3. Switches have a life of at least 5 million operations. All membrane switches shall be “splash proof” and environmentally sealed by a combination of layers of a velvet-grain, highly durable, polycarbonate and glossy polyester. All switches are defined by the 0.020 velvet-grain polycarbonate “switch locator” overlay. The numeric keypad, on-off rocker clock and score switches shall give “tactile feedback” to the operator.
4. Operating features include cumulative memory, time-of-day display to allow the scoreboard to display time-of-day for non-sport display and tenth-of-a-second timing to allow more accurate timing during last minute of play..

B. Console Includes:

1. Protective, weather resistant carrying case. Construction shall be a plastic case 15 inches long by 3 3/4” inches high by 12 inches deep..
2. Shall include four lines of 16 large backlit LCD characters showing information as sent to the scoreboard display and allows operator to see LCD in low-light areas.
3. Furnished with a 10’ low voltage data cable cord to connect to control receptacle junction box and shall unplug and store inside the carrying case. Does NOT require hazardous 120 VAC electrical power.
4. Control cable to connect to the control receptacle junction box (wired system only).
5. Red LED indicators to indicate clock-running up or down, auto-horn “on” status for end of period and auto-horn “on” status for substitution of players.
6. Soft-sided carrying case.

C. Accessory Equipment:

1. 2.4 GHz spread spectrum radio system with frequency hopping technology and 64 non-interfering channels; system includes a transmitter installed inside the console and a receiver installed inside the scoreboard(s).
2. Hard carrying case.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Wall supports to be installed by building contractor to support the scoreboard at location shown on the drawings. Verify that surfaces scoreboard will be mounted on are ready to receive work. Verify that placement of conduit and junction boxes are as specified and indicated in plans and shop drawings.

3.2 INSTALLATION - SCOREBOARD

A. Power conduit, cables and outlet boxes to be provided and installed by the electrical contractor. Signal raceways conduit and boxes to be provided by the electrical contractor.

B. Electrical contractor is responsible for pulling, signal wire and terminators between each scoreboard and control location. Scoreboard vendor to terminate signal wire of controller and conduit scoreboard.

C. Mount scoreboards and interior displays to wall in location detailed and in accordance with manufacturer's instructions. Unit to be plumb and level.

3.3 INSTALLATION – CONTROL CENTER

A. Provide boxes, cover plates and jacks as required to meet control specifications requirements. Control cables to control panels shall be concealed.

B. Test the operation of the scoreboard, controller and all control jacks, leave control unit in carrying case and other loose items with owner's designated representative.

C. Conduct operator training on the scoreboard/controller operation.

3.4 TRAINING AND FINAL HOOKUPS

A. Perform one hour operator training session with up to three end-user identified operators.

B. Perform final termination and hookups of display.

END OF SECTION 116640

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SECTION 116660 - EXTERIOR MARQUEE LED SIGNAGE

GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes:

1. Programmable LED electronic signage.
2. Control software.
3. Accessories necessary for complete installation.

1.3 REFERENCES

A. Standard for Electric Signs, UL48, CUL48, UL Energy Efficiency Verified (Green Leaf certification).

B. Standard for Control Centers for Changing Message Type Signs.

C. Federal Communications Commission Part 15 Regulations for A Class devices.

D. National Electric Code.

E. Designed to current UBC or IBC standards.

1.4 SUBMITTALS

A. The electronic LED display manufacturer shall provide a complete technical submittal within 60 days of contract award and shall not proceed with LED Matrix manufacture until the submittal is approved.

B. Submit:

1. All LED display manufacturer qualifications, as specified herein.
2. LED display installation drawing.
3. AC Site Power Requirements, including legs and Amps per leg.
4. Mounting requirements and locations.
5. LED display control software operator’s manual.
6. LED display installation and maintenance manual.
7. Shop Drawings: Submit fabrication and installation details and attachments to other work.
   a. Show sign mounting heights, locations of supplementary supports to be provided

by others, and accessories

b. Show message list, typestyles, graphic elements and layout for each sign at least half half size.
c. Show locations of electrical service components.
d. Include diagrams for power, signal, and control wiring

C. Samples: Submit sign assembly showing components and with the required finish, in manufacturer's standard size unless otherwise indicated.

1. Exposed Accessories: Half size sample of each accessory type.

D. Software and Firmware Operational Documentation.

1. Software operating and upgrade manuals.
2. Program Software Backup: On USB media or compact disc, complete with data files.
3. Device address list.
4. Printout of software application and graphic screens.

E. Maintenance Data: Submit data to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. LED display manufacturer shall:

1. Have an onsite quality assurance lab to verify product integrity.
2. Have at least (1) Project Manager with PMI certification. Have a minimum of 75 years electrical manufacturing experience and 20 years of LED display manufacturing experience prior to the contract bid date.
3. Have a minimum of 50,000 permanently mounted LED displays in operation for a minimum period of one (1) year prior to the contract bid date.
4. Provide support via domestic, toll-free help desk and an online service knowledge base.
5. Provide proof of liability coverage of $10,000,000 aggregate.

B. Manufacturing experience with the following types electronic signs shall not satisfy the requirements:

1. Matrix displays that show a limited quantity of messages.
2. LCD displays.
3. Back-lit displays.

C. Regulatory Requirements:

1. Building Code: Comply with requirements of AHJ and signage ordinance requirements.

2. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
3. Welding: Qualfy procedures and personnel according to AWS D1.2 Structural Welding Code – Aluminum.
4. Accessibility Requirements: Comply with applicable requirements.

a. U.S. Architectural and Transportation Barriers Compliance Board Americans with Act Accessibility Guidelines for Buildings and Facilities (ADAAG) 2010.
b. ICC/ANSI A117.1 Accessible and Useable Buildings and Facilities.
c. Texas Accessibility Standards (TAS 2012.

1.6 FIELD CONDITIONS

A. Field Measurements: Verify locations of anchorage devices and electrical service embedded in permanent construction by other installers by field measurements before fabrication, and indicate measurements on Shop Drawings.

1.7 COORDINATION

A. Furnish templates for placement of sign anchorage devices embedded in permanent construction by other installers.

B. Furnish templates for placement of electrical service embedded in permanent construction by other installers.

1.7 WARRANTY

A. Warranty against material defects in material and workmanship for five (5) years from the date of shipment from factory dock.

B. Provide a ten (10) year parts availability guarantee.

C. Replacement parts shipped the same day when requested by 3 p.m. CT.

D. Provide toll-free service coordination.

E. Lifetime free technical support and training.

PART 2 - PRODUCTS

2.1 PERFMORMANCE REQUIREMENTS

A. UL 48, CUL 48; Complies with FCC Part 15 regulations for Class A devices.

B. Environmental Rating: IP 65 per face.

C. Cabinet Temperature Rating: -40 °F to +140 °F (-40 °C to +60 °C) with automatic shut-down if temperature exceeds 149 °F (65 °C).

D. Weatherproof: Tested per ASTM B-117 to a continuous 95 °F (35 °C), 7.2 pH salt fog.

E. Windload Rating: Complies with IBC 2012/2015/2018, ASCE7-16

F. Dimming: Photocell, auto-adjustment from 1% - 100% brightness; Software backup.

G. Password protected Security

H. Compatible Graphics: Import capability from most AVI sources; BMP, GIF, JPG and other graphic file types.

I. Video Formats: Most AVI and WMV formats; Options include DVI and HDMI.

J. Brightness: 10,000 nits (max).

K. Calibration: Digit batch inspection, pixel to pixel and module to module.

2.2 MARQUEE SIGNAGE

A. Basis of Design Product: GT6x 10 mm Full Color Galaxy LED Display Signs as manufactured by Daktronics. Other manufacturers must have a minimum of five (5) years experience manufacturing products meeting or exceeding the specifications and Comply with Division 1 requirements regarding substitutions to be considered:

1. Poblocki Sign Company.
2. Polyvision Corporation.
3. Spectrum Scoreboards..

B. Double Sided Full Color LED Display

1. Color capability: 281 Trillion Colors.
2. Character height: 2.8 inches and larger.
3. Line and Column Spacing: 10 mm.
4. Lifetime (.5 Brightness): 100,000 hours.
5. Horizontal Viewing Angle: 160 degrees.
6. Vertical Viewing Angle: 70 degrees.
7. Maximum Viewing Distance: 21 feet.
8. Contrast Enhancement: Non-reflective black louvers and module face grooves disperse light.
9. Graphic Capability: Text, graphics, logos, basic animation, video clips, multiple font style and sizes.
10. Control Software: Venus Control Suite.
11. Power: 120/240 VAC Single Phase.
12. Display Dimming: 64 levels.
13. Compliance Information: UL Listed, FCC compliance.
14. Maximum Brightness: 8,000 units.
15. Pixel Configuration: 3-in-1 SMD.

2.3 LED DISPLAY

A. Cabinet Construction

1. Cabinet dimensions shall not exceed height and width required for integration into structure indicated on drawings. The front-to-back cabinet depth shall not exceed 8 inches.
2. Display configuration is twin view, two sided display
3. The distance from the center of one line or column of pixels to the center of all adjacent lines or columns shall be Line Spacing 19.05mm both horizontally and vertically.
4. Cabinet weight per face shall not exceed 9lbs/sq ft
5. Display shall operate from the following power sources: 120/240 VAC, 60 Hz single-phase, including neutral and earth ground.
6. Display shall operate in a minimum ambient temperature range of -40° to +140°F (-40 to +60°C) and to a 95% humidity.
7. Internal display component hardware (nuts, bolts, screws, standoffs, rivets, fasteners, etc.) shall be fabricated from stainless steel, aluminum, nylon, or other durable corrosion-resistant materials suitable for the signage application.
8. Module components shall be 100% solid-state.
9. Display performance may not cause harmful radio, magnetic or electromagnetic interference. The display must accept any interference received, including interferences that may cause undesired operation.

B. Housing Frame

1. Display materials shall use non-corrosive materials or have a protective coating so they shall be anti-corrosive and not degrade or oxidize.
2. Cabinets must be constructed from extruded aluminum with precision-mitered corners, solid welds, and
3. stainless fasteners.
4. The display shall be front or rear ventilated with adequate ventilation provided by the use of fans.
5. Steel mounting points that can be used for mounting purposes shall be provided with the display and have the ability to be adjusted for alternative mounting methods.
6. Shall include lifting supports that can be removed after installation.

C. Exterior Finish: LED display front-facing cabinet shall be coated with a baked acrylic enamel.

D. Front Face Construction

1. To meet the display readability requirements, the front face must be constructed in such a manner that it provides high contrast, low sunlight reflection and durability in all weather and site conditions.
2. Minimum features of front face shall:

    a. Provide UV resistance to prevent discoloring.
    b. Include horizontal louvers over LEDs for contrast enhancement and sunlight shading.
    c. Include vertical light traps to reduce light spill.
    d. Use surface materials in the active LED area, such as metal, plastic, or other face materials, designed for low sunlight reflectivity.

E. Serviceability

1. The display housing shall provide safe and convenient rear and/or front service access for all modular assemblies, components, wiring, and other materials located within the housing.
2. All internal components shall be removable and replaceable by a single technician with proper tooling.
3. Service access shall be easily obtained by removal of one or more modules in front of the associated internal component and/or rear access panel.
4. Each module should allow easy removal with a latch with positive stops.
5. Displays shall be designed with service features that minimize potential bodily harm.

2.4 DISPLAY COMPONENTS

A. LED display modules shall be constructed for good readability, long life, and ease of service. Each display module shall be constructed as follows:

1. Each module within the product family shall be designed with the same physical footprint of 12” x 12”.
2. All modules and their components shall be fully encapsulated and sealed to meet IP-67 standards.
3. An LED module shall consist of LEDs with all drive electronics mounted on a single Printed Circuit Board (PCB).
4. LEDs shall be auto-inserted in order to maintain quality and uniformity of the LEDs within each LED module.
5. All surface mount LEDs shall be soldered using a reflow process to ensure uniformity, quality, and durability of all solder joints.
6. All PCBs shall be cleaned in a manner so as not to contain more than 2 parts per million contaminants.
7. Module signal and electrical connections shall be of the positive locking and removable type. Removal of a module from the display shall not require a de-soldering operation.
8. All LED display modules in a single display shall be identical in construction and interchangeable throughout the display with the ability to be field calibrated.
9. Modules shall be individually attached to the cabinet frame.
10. Removal of one or more modules shall not affect the display’s structural integrity.
11. The distance from the center of one line or column of pixels to the center of all adjacent lines or columns shall be 19.05mm both horizontally and vertically.
12. Confines high speed data signals to individual smart LED modules, each with its own microcontroller that runs the LEDs.
13. The display must not send high speed data signals from a receiver card to the module over multi-conductor cables to display an image.
14. The failure of a single pixel, module or power supply shall not cause the failure of any other pixel, module or power supply in the display.
15. All modules shall have no less than a 140° horizontal half-intensity viewing angle.
16. The transition of the viewing intensity shall be consistent throughout the viewing cone.

B. Pixels shall be constructed with discrete LEDs, and these discrete LEDs shall conform to the following specifications:

1. LEDs shall be non-diffused, ultra-bright, solid-state light emitting diodes.

2. Each color of LEDs used in all LED displays provided for this contract shall be from the same bin.
3. LED half-life shall be an estimated minimum of 100,000 hours.
4. Display shall have a minimum intensity of 10,000 nits maximum light output.

C. Power Supply

1. All power supplies shall be regulated, auto-ranging AC to DC power, with protection for the LED pixel, LED display and driver circuitry in the event of power spikes or surges.
2. Each power supply and their connectors shall be fully sealed to protect from corrosive environmental factors meeting IP-67 standards.

D. Internal Wiring

1. Use smart module design to minimize cables needed, reduce potential points of failure and reduce Mean Time Between Failures (MTBF).
2. Cables must be engineered and tested to withstand environmental conditions by using high grade automotive connectors instead of insulation displacement (ribbon-type cables) connectors.
3. Wiring for LED display modules and other internal components shall be installed in the housing in a neat and professional manner.
4. Wiring shall not impede the removal of display modules, power supplies or other display components.
5. Wires shall not make contact with or be bent around sharp metal edges.
6. All wiring shall conform to the National Electric Code.

E. The display shall be protected from electrical spikes and transients.

F. The manufacturer shall provide an earth-ground lug on the display.

2.5 DISPLAY PERFORMANCE

A. Display Capability

1. The LED display shall present messages that are continuous, uniform, and unbroken in appearance.
2. The LED display shall be capable of producing 281 trillion colors.
3. Each display pixel shall be composed of one each – red, green, and blue LEDS.
4. The display shall be able to display messages composed of any combination of alphanumeric text, punctuation symbols, and graphic images.
5. Video and message files shall have up to a 30 frame per second playback capability.

B. Controller

1. The display’s controller shall be able to run independently from a content management system, allowing the display to continue to operate even if the controlling system is unreachable.
2. Each controller shall be connected to a light sensor allowing each LED display to automatically adjust brightness according to display direction and lighting conditions.

3. The controller shall allow connection to a temperature sensor that provides accurate site temperatures.
4. Active presentations, stored presentations, schedules, display configuration, time and date shall be stored in non-volatile memory. No external power or battery backup will be required to maintain this data.

C. Control and Communications

1. The display controller should be DHCP-enabled and allow for static IP addressing.
2. Each single-face display shall be controlled and monitored by its own LED controller.
3. The LED controller shall be able to receive instructions from and provide information by accessing Ignite using one of the following communication modes as directed by Owner:

    a. Internet via Ethernet Cat5 wire
    b. Ethernet cellular modem
    c. Fiber-optic cable
    d. Point-to-point RWF radio
    e. Point-to-point high security radio

2.6 CONTROL SOFTWARE

A. Provide one of the following options as directed by Owner.

1. Control Software Option 1: Create, schedule and deliver content via Venus Control Suite cloud-based software. Software to be hosted on manufacturer’s servers at no cost to the customer.

    a. Includes browser-based online editor for creating content, multiple content zones, playlists
    b. Able to integrate widgets and RSS feeds.
    c. Include a content library of more than 1000 pieces of graphics and animations.
    d. Allows for smart scheduling, which eliminates competing products to display in the same daypart.
    e. Import and store JPG, GIF, PNG, and TGA image files; MP4 video files with HD 1080 capability; MP3, WAV and WMA audio files.

2. Control Software Option 2: Create, schedule and deliver content on a closed, military secure circuit via Venus Control Suite..

    a. Includes PC-based editor for creating content and playlists; schedule messages; and integrate time and temperature.
    b. Include a content library of more than 1000 pieces of graphics and animations.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Mounting structure to be installed by contractor to support desired displays in all locations. Verify that separate conduit is in place for power and data to display, unless fiber is being used. Verify that all control equipment has access to 120/240 VAC.

3.2 INSTALLATION

A. Support structure design depends on the mounting methods, display size, and weight. The structure design is critical and should be done only by a qualified individual. It is the customer's responsibility to ensure that the structure and mounting hardware are adequate.

B. It is the customer's responsibility to ensure that the installation meet local standards. The mounting hardware shall be capable of supporting all components to be mounted.

C. All mounted displays must be inspected by a qualified structural engineer.

D. Possible power and signal entrances are designated by etched markings. Separate conduit must be used to route the power, signal in wires, and signal out wires.

E. Displays must be grounded according to the provisions outlined in Article 250 of the National Electrical Code. The display must be connected to earth-ground. Proper grounding is necessary for reliable equipment operation and protects the equipment from damaging electrical disturbances and lightning.

F. All installations shall conform to Article 600 of the National Electrical Code.

3.3 DEMONSTRATION AND TRAINING

A. Comply with requirements of Section 017900 "Demonstration and Training."

END OF SECTION 116660

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SECTION 210000 - FIRE PROTECTION

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

B. The Basic Materials and Methods, Section 220200, are included as a part of this Section as though written in full in this document.

1.2 SCOPE

A. The scope of the work shall include the furnishing and complete installation of the fire protection piping, valves, hose connections, and equipment covered by this Section, with all appurtenances, ready for owner's use.

1.3 RELATED WORK

A. Section 210201 - Coordination Drawings

B. Section 210529 - Hangers and Supports for Fire Suppression Piping and Equipment

C. Section 211313 - Wet Pipe Sprinkler System

D. Section 211316 - Dry Pipe Sprinkler Systems

E. Section 213113 - Fire Pumps, Electric Drive

F. Section 221200 - Facility Potable-Water Storage Tanks

1.4 REFERENCES

A. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

B. ASTM A135/A135M - Standard Specification for Electric-Resistance-Welded Steel Pipe

C. ASTM A795/A795M - Standard Specification for Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use

D. FM Global Fire Protection Standards

E. NFPA 13 - Standard for the Installation of Sprinkler Systems

F. NFPA 14 - Standard for the Installation of Standpipe and Hose Systems

G. UL - Underwriters Laboratories

1.5 QUALITY ASSURANCE

A. Manufacturer: For each product specified, provide components by the same manufacturer throughout.

B. Valves: Manufacturer's name, size, and pressure rating shall be cast or marked on valve body or handle.

C. Piping shall be labeled along its entire length indicating size, class, material specification, manufacturer’s name and country of origin.

D. Domestic Manufacture: All valves, pipe, fittings, hose connections, and equipment shall be by a domestic manufacturer.

1.6 SUBMITTALS

A. Submit shop drawings in accordance with Section 220200 and as described below.

B. Submit shop drawings of entire water-based building fire protection system with all standpipe, hose valve, and hose connection locations, including the accompanying hydraulic calculations to the Architect/Engineer for review. **A current and fully documented fire hydrant flow test must be included.**

C. Submit complete product data for 213113 - Fire Pumps, Electric Drive concurrently with the submittal for this Section, for all systems served by such equipment.

D. Service Utility Diagram: Furnish Architect with an accurately marked print showing location of underground pipes and valves as installed upon completion of underground work.

E. Submit product data to include pipe materials, pipe fittings, valves, hose connections, waterflow and alarm devices, and other appurtenances. Provide manufacturer’s catalog information, product certifications, and **country of origin**. Indicate valve data and ratings.

1.7 REGULATORY REQUIREMENTS

A. Work in accordance with:

1. NFPA 13 - Standard for the Installation of Sprinkler Systems.
2. NFPA 14 - Standard for the Installation of Standpipe and Hose Systems
3. NFPA 24 - Standard for the Installation of Private Fire Service Mains and Their Appurtenances
4. NFPA 25 - Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems

5. Local codes that have jurisdiction.

B. Products in accordance with:

1. UL (Underwriters Laboratories) listed.
2. FM (Factory Mutual) approved.
3. Requirements of the local Authority Having Jurisdiction (AHJ).

1.8 CERTIFICATE OF TESTING

A. Furnish Owner with test certificate certifying the system approved by:

1. Fire Marshal.
2. Insurance Services Officials.

PART 2 - PRODUCTS

2.1 GENERAL

A. Work included:

1. The Drawings provide a preliminary layout with locations of water service entry/water supply, control valves, hose connections, and fire department connection(s). These are a guide for the subsequent preparation of the Licensed Fire Sprinkler Contractor's detailed working drawings.
2. Coordinate work and installation with electrical and fire alarm contractors accordingly to interface system with the building fire and smoke alarm systems.

B. Requirements:

1. Materials and installation to meet or exceed the requirements of NFPA 13 and 14, (prevailing editions) and the local authority having jurisdiction (AHJ).
2. All components of the system shall be UL listed for the intended service.
3. Provide components with minimum pressure ratings as suited for system working pressure(s).
4. All hose connections shall be provided with approved threads, caps, and chains.

2.2 FIRE HOSE VALVES, CONNECTIONS, AND EQUIPMENT

A. General requirements: All hose valves shall be listed. All hose connections shall be provided complete with connections, caps and chains conforming to local Fire Department requirements.

B. Acceptable Manufacturers:

1. Potter-Roemer
2. Dixon
3. Elkhart Brass

4. Croker

C. FIRE DEPARTMENT CONNECTIONS: No less than 4" and two-way type, with additional connections and in larger size in accordance with system demand per NFPA. Polished chrome plated brass with lettering consistent with system type and service. Back, top, or bottom outlet as required for placement and wall construction for building mounted variations. Provide complete with accessibly located, listed check valve with approved automatic drip valve. Potter-Roemer Model 5751 (building mounted), Model 5761 (free-standing) or similar model with features as required and as described above.

PART 3 - EXECUTION

3.1 DESIGN

A. The Contractor shall conform to the requirements of NFPA 14 for standpipe and hose system design and installation. It shall be the Contractor's responsibility to determine if any deficiency or deviations exist, such as an inadequate water supply, or any other item which would materially affect the acceptability of the system.

3.2 INSTALLATION

A. Install all items in accordance with applicable codes.

B. Piping shall be protected accordingly where subject to mechanical damage and/or fire damage.

C. Do not install risers or mains in MDF/IDF/Data closets or electrical rooms. Where sprinkler protection is provided, only the associated branch lines and sprinkler heads shall be allowed in such spaces.

D. Piping (mains and standpipes) shall be protected accordingly from freezing temperature with the use of supervised and listed heat tracing with insulation and jacketing.

E. In all locations subject to corrosive conditions, ensure to provide a suitable epoxy (spray) coating to all exposed surfaces of pipe and fittings. All job-applied protective coatings shall be provided as approved and only after verification that the proper piping has been installed, per the markings along the length of the pipe.

F. Piping in finished spaces shall be routed concealed. This shall not include areas such as mechanical spaces, parking garages, and stairways. Exact routing of piping shall be approved by Architect or relocated as required at no additional cost to Owner.

G. All standpipes shall be provided with a means of draining and shall be arranged to discharge water at an approved location.

H. Identify all locations requiring coordination with the electrical and fire alarm contractors accordingly to ensure connectivity with the building fire and smoke alarm systems. This shall

include, but is not necessarily limited to, the following: water flow switches, alarm bells, and tamper/supervisory switches at control valves.

I. At building expansion joints provide approved system expansion joint fittings/assemblies accordingly and per manufacturer's recommendations and NFPA 13 requirements. Victaulic Style 155 carbon steel expansion joint for sizes up to and including 12" pipe.

3.3 PAINTING AND PIPE IDENTIFICATION

A. Painting of fire protection piping and appurtenances shall be provided as follows:

1. Surfaces to be painted shall be cleaned as necessary to ensure they are free from dirt and oils.
2. Unless directed otherwise by Architect, heat and water resistant, air-cured, high performance one-part epoxy paint shall be provided. Coating shall be high-gloss, lead-free, suited for indoor and outdoor use, and USDA approved. Armor-Poxy or similar.
3. Fire sprinkler risers and associated alarm valves and related piping exposed in occupied spaces shall be painted red.
4. Fire protection and sprinkler piping exposed in occupied spaces shall be painted as directed by Architect.
5. Fire protection and sprinkler piping exposed in unoccupied accessory areas such as stairways shall be painted red unless directed otherwise by Architect.

B. Identification of fire protection piping shall be provided as follows:

1. All interior visible piping located in accessible spaces shall be provided with pipe markers. Accessible spaces shall include, but not necessarily be limited to, the following: above accessible ceilings, inside equipment rooms and utility spaces, in attic spaces, in crawl spaces, and in chase spaces, etc. viewable via access panels.
2. All exterior visible piping shall be provided with pipe markers.
3. Peel-off, self-adhesive, sticker type labels shall not be acceptable.
4. Pipe markers shall be manufactured with rigid vinyl PVC, printed with UV resistant ink, abrasion, and chemical resistant, suited for indoor or outdoor use and for a service temperature of -40 degrees F to 160 degrees F.

    a. For pipes up to 6” provide cylindrically pre-coiled markers that snap into place without the need for tape or adhesives.
    b. For pipes 6” and larger provide flat snap-around markers installed using manufacturer’s heavy-duty nylon ties or stainless-steel strapping.
    c. Markers shall indicate the pipe service, include flow directional arrows, and meet ASME A13.1.

5. Acceptable manufacturers:

    a. Seton Setmark Pipe Markers
    b. Brimar Industries Pipemarker System 1 Pipe Markers
    c. Brady Corporation

6. Markers shall be provided after final insulation, painting, jacketing, etc. of piping and per manufacturer's installation instructions. Strapping (applies to large diameter markers only) shall be snug but shall not compromise any insulation. All such strapping shall also be cleanly trimmed of excess material.
7. Markers shall be provided in accordance with ASME A13.1 requirements. **Specific items indicated below are not intended as a substitute for this complete standard**. Markers shall be provided:

    a. On both sides of each floor or wall penetration.
    b. On each side of each tee.
    c. On each side of each valve and/or valve group.
    d. On each side of each piece of equipment.
    e. On straight pipe runs at equally spaced intervals not to exceed 50 feet.
    f. In congested areas, on each pipe at the point it enters and exits the area.
    g. At the point of connection to each piece of equipment and automatic control valve.
    h. Where they are readily visible to personnel from the point of normal approach.
    i. With letter height and length of color field according to the size of the pipe served.

8. Color scheme of markers shall be as indicated below and otherwise in accordance with ANSI/ASME color recommendations. Legend color indicates color of legend text and flow directional arrow:

SYSTEM	LABEL COLOR	LEGEND	LEGEND COLOR
Fire Protection	Red	Fire Protection	White
	Red	Fire Sprinkler	White

3.4 REPLACEMENT

A. Upon receipt of written notice of failure of any part of the guaranteed equipment during the guaranteed period, the Contractor will replace the affected part or parts promptly at no additional cost.

3.5 TESTING

A. Upon completion of the installation, test the system and obtain approval of the local fire insurance rating organization having jurisdiction.

3.6 TRAINING

A. Owner's people shall be fully briefed in the normal start-up of the system, operation, normal and emergency shutdown, and maintenance of the system.

B. Routine maintenance, yearly maintenance, winterization, and spring start-up shall be fully discussed and documented.

C. Names of those instructed and dates, as well as a list of information handed over to the owner, shall be included in the final report.

END OF SECTION 210000

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SECTION 210201 - COORDINATION DRAWINGS

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions 01 31 00 and Supplementary Conditions apply to all Work herein.

1.1 COORDINATION DRAWINGS

A. The Contractor shall take the lead in coordinating the Mechanical, Electrical, Plumbing, Communications, Electronic Safety/Security and Fire Protection systems within the building.

B. The Contractor shall coordinate a three-dimensional (3D) model of the building which includes the Mechanical, Electrical, Plumbing, and Fire Protection systems. The Contractor will be provided with the REVIT model that was used to generate the contract documents, and this file may be used as the background file. The Contractor shall replace the systems drawn with the actual shop drawing models. The Contractor is not limited to using REVIT and may use any 3-D software in generating and combining the coordination model.

C. Submitting the contract drawings as coordination drawings will not be acceptable.

D. The model shall include detailed and accurate representations of all equipment to be installed based upon the reviewed equipment submittals.

E. The Contractor shall hold a 3-D coordination meeting with all sub-contractors present to review the model and discuss coordination of the installation of the building systems.

F. Upon completion of the coordination meeting, the Contractor shall submit the 3-D model and 1/4” scale drawings for review.

G. The model shall detail major elements, components, and systems in relationship with other systems, installations, and building components. Indicate locations where space is limited for installation and access and where sequencing and coordination of installations are of importance to the efficient flow of the Work, including (but not necessarily limited to) the following:

1. Indicate the proposed locations of pipe, duct, equipment, and other materials. Include the following:

    a. Wall and type locations.
    a. Clearances for installing and maintaining insulation.

    b. Locations of light fixtures and sprinkler heads.

    c. Clearances for servicing and maintaining equipment, including tube removal, filter removal, and space for equipment disassembly required for periodic maintenance.

d. Equipment connections and support details.

e. Exterior wall and foundation penetrations.

f. Routing of storm and sanitary sewer piping.

g. Fire-rated wall and floor penetrations.

h. Sizes and location of required concrete pads and bases.

i. Valve stem movement.

j. Structural floor, wall and roof opening sizes and details.

2. Indicate scheduling, sequencing, movement, and positioning of large equipment into the building during construction.
3. Prepare floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.
4. Prepare reflected ceiling plans to coordinate and integrate installations, air distribution devices, light fixtures, communication systems components, and other ceiling mounted items.

H. Sequence of Coordination

5. Below is the hierarchy of model elements and the sequencing by which the models will be coordinated.
   a. Structural and Architectural model

   b. Miscellaneous steel

   c. Perform preliminary space allocation

   d. Identify hard constraints (locations of access panels, lights, A/V space requirements, etc.)

   e. Main and medium pressure ducts from the shaft out

   f. Main graded plumbing lines and vents

   g. Sprinkler mains and branches

   h. Cold and hot water mains and branches

   i. Lighting fixtures and plumbing fixtures

   j. Smaller sized ducts and flex ducts

   k. Smaller size cold water and hot water piping, flex ducts, etc.

I. The Contractor shall not install any item until the coordination has been completed and reviewed by the Construction Manager, Owner, and A/E team.

J. The Contractor shall be responsible for coordination of all items that will affect the installation of the Work. This coordination shall include, but not be limited to: voltage, ampacity, capacity, electrical and piping connections, space requirements, sequence of construction, building requirements and special conditions.

K. By submitting shop drawings on the project, the Contractor is indicating that all necessary coordination has been completed and that the systems, products, and equipment submitted can be installed in the building and will operate as specified and intended, in full coordination with all trades.

END OF SECTION 210201

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SECTION 210529 - HANGERS AND SUPPORTS FOR FIRE SUPPRESSION PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Pipe hangers, supports, and associated appurtenances.

B. Sleeves and seals.

1.2 RELATED WORK

A. Section 210000 - Fire Protection

B. Section 211313 - Wet Pipe Sprinkler System

C. Section 211316 - Dry Pipe Sprinkler Systems

D. Section 213113 - Fire Pumps, Electric Drive

1.3 REFERENCES

A. ASME B31.1 - Power Piping.

B. NFPA 13 - Standard for the Installation of Sprinkler Systems.

C. NFPA 14 - Standard for the Installation of Standpipe and Hose Systems.

1.4 QUALITY ASSURANCE

A. Supports for Sprinkler Piping: In conformance with NFPA 13.

B. Supports for Standpipes: In conformance with NFPA 14.

1.5 SUBMITTALS

A. Submit shop drawings and product data under the provisions of Division One.

B. Indicate hanger and support framing and attachment methods.

PART 2 - PRODUCTS

2.1 PIPE HANGERS AND SUPPORTS

A. Hangers for Pipe Sizes up through 2 Inch: Carbon steel, adjustable swivel ring type with rounded edge design, UL listed, and FM approved. Anvil International Figure 69.

B. Hangers for Pipe Sizes 2-1/2 Inch and larger:

1. Carbon steel, adjustable clevis type, UL listed, and FM approved. Anvil International Figure 260.
2. Carbon steel, adjustable swivel ring type, UL listed, and FM approved. Anvil International Figure 69.
3. Carbon steel, UL listed straps & hangers with beveled edge design and/or plastic coating for abrasion protection of and intended for use with CPVC piping (only where such pipe material is specified). Anvil International.

C. Building structure attachments for hangers: Ductile iron, universal C-type clamps, UL listed, and FM approved. Anvil International Figure 92, 93, 94.

D. Vertical Piping Supports: Carbon steel riser clamp. Anvil International Figure 40.

E. Floor Supports for pipe headers and similar horizontal runs of pipe: Steel pipe stand assembly.

1. Cylindrical pipe stanchion assembly complete with malleable iron flange or welded steel flange base plate secured to the floor by an approved method with listed anchors.
2. Each base plate shall be attached to the floor with a minimum of four (4) anchors no smaller than 1/2" diameter, per NFPA 13.
3. Provide pipe saddle support with steel U-bolt yoke and nuts to attach piping to each stand.
4. Anvil International Figure 63, Type P with Figure 259 saddle support.

F. Equivalent UL listed, FM approved hanger and support products by Eaton B-Line shall also be acceptable.

G. For installation of protective shields refer to Article 3.3.

2.2 HANGER RODS

A. Galvanized or cadmium plated carbon steel hanger rods: Threaded both ends, threaded one end, or continuous threaded. Provide rod couplings in matching finish.

2.3 INSERTS/FASTENERS

A. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

B. Fasteners: For wood construction and for metal purlin and metal deck applications only, the use of appropriate self-drilling fasteners (UL listed, FM approved, manufactured in USA) provided in accordance with manufacturer's recommendations shall be acceptable. ITW Buildex "Sammys" products or pre-approved equal.

2.4 SLEEVES

A. All pipe penetrations through walls, floors, floor-ceiling assemblies, etc. shall be sleeved to ensure no direct contact between the pipe and that which it passes through. All installations shall be provided consistently with the fire and smoke safeguards required by the building code per the fire-resistance rating as indicated on the architectural drawings and shall be provided consistent with the assemblies/methods indicated on the architectural drawings.

B. Unless required otherwise (the most stringent requirement shall govern), sleeves for pipes:

1. Through nonfire-resistance-rated floors, they shall be formed with 18 gage galvanized steel, tack welded to form a uniform sleeve.
2. Through nonfire-resistance-rated walls, through grade beams and foundation walls, and through potentially wet floors shall be formed with schedule 40 steel pipe, galvanized.
3. Through assemblies including but not limited to fire-resistance-rated walls-barriers-partitions, smoke barrier-partitions, etc. shall be schedule 40 steel pipe securely fastened to the rated assembly. All annular spaces shall be firestopped with an approved penetration firestop system (UL listed) compatible with the pipe material and installed per the manufacturer's recommendations.

C. Fire Stopping Insulation: Glass fiber type, non-combustible, UL listed.

D. Caulk: Paintable 25-year acrylic sealant.

E. Pipe Alignment Guides: Factory fabricated, of cast semi-steel or heavy fabricated steel, consisting of bolted, two-section outer cylinder and base with two-section guiding spider that bolts tightly to pipe. The length of guides shall be as recommended by the manufacturer to allow indicated travel.

2.5 FABRICATION

A. Size sleeves are large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.

B. Design hangers without disengagement of supported pipe.

2.6 FINISH

A. Exposed steel hangers, supports, and appurtenances shall be hot-dipped galvanized. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

PART 3 - EXECUTION

3.1 INSERTS

A. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams. Coordinate with structural engineers for placement of inserts.

B. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.

C. Where concrete slabs form finished ceiling, provide inserts to be flush with slab surface.

D. Where inserts are omitted, drill through concrete slab from below and provide thru-bolt with recessed square steel plate and nut recessed into and grouted flush with slab. Verify with structural engineer prior to start of work.

3.2 PIPE HANGERS AND SUPPORTS

A. Support horizontal piping with maximum distance between hangers and minimum hanger rod diameters as follows:

Pipe Size	Max. Hanger Spacing	Min. Rod Diameter
(Steel Pipe)		
1 to 1-1/4 inch	10'-0"	3/8"
1-1/2 to 3 inch	12'-0"	3/8"
4 to 6 inch	12'-0"	1/2"
8 to 10 inch	12'-0"	5/8"
12 to 14 inch	12'-0"	3/4"
(CPVC Pipe, only where specified)		
3/4 to 1 inch	4'-0"	3/8"
1-1/4 to 1-1/2 inch	4'-0"	3/8"
2 to 3 inch	6'-0"	3/8"

B. Where a listed CPVC pipe manufacturer’s maximum hanger spacing is more stringent than the spacing above, it shall be followed.

C. Spacing of hangers for unbroken lengths of CPVC pipe shall be permitted to be increased to a maximum of 5’-6” for 3/4" piping and 6’-0” for 1” through 1-1/2” piping.

D. Ensure to adequately secure sprinkler piping to restrict the movement of piping upon sprinkler operation. Where listed CPVC pipe is specified, supports must be provided as required in accordance with the pipe manufacturer’s recommendations.

E. Install hangers to provide a minimum 1/2 inch space between finished covering and adjacent work.

F. Place a hanger within 12 inches of each horizontal elbow and at the vertical to horizontal transition.

G. For piping 2 inches and larger, provide additional hangers at offsets and changes in horizontal direction of piping. Where the spacing of adjacent hangers for the piping does not exceed the distance limits in NFPA 13, such additional hangers shall still be provided.

H. Use hangers with 1-1/2-inch minimum vertical adjustment.

I. Ensure that hanger rods are only loaded axially (along the rod). Provide additional hangers or restraints as necessary to minimize non-axial loads

J. Threaded sections of rod shall not be formed or bent, neither prior to nor as a result of installation.

K. Support vertical piping at every floor. Distances between supports for risers shall not exceed 25 feet.

L. In multi-story buildings (in addition to on every floor) riser supports shall be provided at the lowest level, above and below offsets, and at the top of the riser.

M. Where several pipes can be installed in parallel and at the same elevation, provide multiple or trapeze hangers.

N. Support riser piping independently of connected horizontal piping.

O. Install hangers with a nut at the base and above the hanger; tighten upper nut to hanger after final installation adjustments.

P. Where piping is subject to seismic activity, ensure to provide protection measures in accordance with NFPA 13 requirements.

3.3 INSULATED PIPING

A. Comply with the following installation requirements.

B. Clamps: Attach galvanized clamps, including spacers (if any), to piping with clamps projecting through insulation; do not exceed pipe stresses allowed by ASME B31.9.

C. Saddles: Install galvanized protection saddles MSS Type 39 where insulation without vapor barrier is indicated. Fill interior voids with segments of insulation that match adjoining pipe insulation.

D. Shields: Install protective shields MSS Type 40 on cold and chilled water piping that has vapor barrier. Shields shall span an arc of 180 degrees and shall have dimensions in inches not less than the following:

Nominal Pipe Size	Length	Thickness
1/4 through 3-1/2 inch	12 inch	0.048 inch
4 inch	12 inch	0.060 inch
5 through 6 inch	18 inch	0.060 inch
8 through 14 inch	24 inch	0.075 inch
16 through 24 inch	24 inch	0.105 inch

E. Piping 2” and larger provide galvanized sheet metal shields with calcium silicate at hangers/supports.

F. Insert material shall be at least as long as the protective shield.

G. Thermal Hanger Shields: Install where indicated, with insulation of the same thickness as piping.

3.4 EQUIPMENT BASES AND SUPPORTS

A. Provide equipment bases of concrete.

B. Provide templates, anchor bolts, and accessories for mounting and anchoring equipment.

C. Construct support of steel members. Brace and fasten with flanges bolted to structure.

3.5 SEALS

A. Provide flexible watertight sealant where piping penetrates waterproofed walls, floors, and roofs.

B. Where dry sprinklers are connected to wet pipe sprinkler systems protecting areas subject to freezing temperatures (such as, but not necessarily limited to, insulated freezer structures) ensure that the clearance space around the sprinkler barrel is completely sealed in accordance with the manufacturer’s recommendations.

3.6 SLEEVES

A. Set sleeves in position in formwork. Provide reinforcing around sleeves.

B. Extend sleeves through floors minimum one inch above finished floor level. Caulk sleeves full depth with fire rated thermafiber and 3M caulking and provide floor plate.

C. Where piping penetrates a floor, ceiling, or wall, close off space between pipe and adjacent work with UL listed fire stopping insulation and caulk seal air tight. Provide close fitting metal collar or escutcheon covers at both sides of penetration.

D. Fire protection sleeves may be flush with floor of stairways.

END OF SECTION 210529

SECTION 211313 - WET PIPE SPRINKLER SYSTEM

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

B. The Basic Materials and Methods, Section 220200, are included as a part of this Section as though written in full in this document.

C. Refer to Section 210000 for integral requirements.

1.2 SCOPE

A. Scope of the work shall include the furnishing and complete installation of the fire protection piping, valves, sprinkler heads, and equipment covered by this Section, with all appurtenances, ready for owner's use.

B. The scope of work shall include the painting and pipe marking of fire sprinkler system piping as described in Section 210000.

C. The scope of work shall include providing UL listed, FM approved factory-assembled automatic release air vents on sprinkler branch lines for the reduction of trapped air in the sprinkler system. Provide each complete with isolation valve, union or quick connect, wye strainer with valve, and drain line to drain in accordance with manufacturer’s recommendations and local requirements.

D. The provision of air vents shall be coordinated with any other systems or treatment for general corrosion or MIC (Microbiologically Influenced Corrosion) that may be specified.

1.3 RELATED WORK

A. Section 210000 - Fire Protection

B. Section 210201 - Coordination Drawings

C. Section 210529 - Hangers and Supports for Fire Suppression Piping and Equipment

D. Section 211314 - Wet Pipe Sprinkler System, Corrosion Mitigation Program

E. Section 211316 - Dry Pipe Sprinkler Systems

F. Section 211317 - Dry Pipe Sprinkler System, Corrosion Mitigation Program

G. Section 213113 - Fire Pumps, Electric Drive

1.4 REFERENCES

A. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2022.

B. ASTM A135/A135M - Standard Specification for Electric-Resistance-Welded Steel Pipe; 2021.

C. ASTM A795/A795M - Standard Specification for Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use; 2021.

D. ASTM F439 - Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80; 2019.

E. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification; 2021, with Errata (2023).

F. NFPA 13 - Standard for the Installation of Sprinkler Systems; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

G. NFPA 14 - Standard for the Installation of Standpipe and Hose Systems; 2024.

H. NFPA 24 - Standard for the Installation of Private Fire Service Mains and Their Appurtenances; 2025.

I. NFPA 25 - Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems; 2023.

1.5 QUALITY ASSURANCE

A. Manufacturer: For each product specified, provide components by the same manufacturer throughout.

B. Valves: Manufacturer's name, size, and pressure rating shall be cast or marked on valve body or handle.

C. Piping shall be labeled along its entire length indicating size, class, material specification, manufacturer’s name and **country of origin**.

D. Domestic Manufacture: All valves, pipe, fittings, sprinkler heads, and equipment shall be by a domestic manufacturer.

E. Welding Procedures and Performance:

1. Meet or exceed the requirements of AWS B2.1/B2.1M “Welding and Brazing Qualifications”; as well as any local AHJ requirements.

2. Maintain and be able to produce complete certified records, including, but not necessarily limited to, the following: Welding Procedure Specifications (WPS's), Procedure Qualification Records (PQR's), and welder qualification records.

1.6 SUBMITTALS

A. Submit shop drawings in accordance with Section 220200 and as described below.

B. Submit product data with manufacturer's catalog information, product certifications, and **country of origin** identified. Indicate valve data and ratings. Product data to be submitted shall include, but not necessarily be limited to, the following:

1. Pipe material
2. Pipe fittings and couplings
3. Sprinkler heads and guards
4. Valves, air release vents, and backflow preventers
5. Waterflow, supervisory and alarm devices
6. Fire-stopping sealant and pipe marker products
7. Spare sprinkler head box, signage, and other accessories
8. Include a schedule of wall sleeves to be provided

C. Product data for hangers and supports *may* be submitted under this section, although these items are specified under Section 210529 – Hangers and Supports for Fire Suppression Piping and Equipment

D. Submit shop drawings of entire sprinkler system with all head locations and including accompanying hydraulic calculations to the Architect/Engineer for review. **A current and fully documented fire hydrant flow test must be included.**

E. Submit complete product data for 213000 - Fire Pumps **concurrently** with the submittal for this Section, for all systems served by such equipment.

F. Provide Architect with six complete sets of final approved shop drawings before starting the installation. Include details of the sprinkler system showing sections, light fixtures, ducts, and a plan indicating fire department connections, location of all exposed structures within twenty feet of this structure, and other equipment to be used. Drawings shall bear the stamp of review of the local fire insurance rating organization having jurisdiction.

G. Service Utility Diagram: Furnish Architect with an accurately marked print showing location of underground pipes and valves as installed upon completion of underground work.

H. Where a project is required to comply with FM Global requirements, ensure to submit a set of drawings, hydraulic calculations, and other required documentation to a designated representative of FM Global for review and acceptance prior to the start of any system installation.

1.7 REGULATORY REQUIREMENTS

A. Work in accordance with:

1. NFPA 13
2. NFPA 14
3. NFPA 24
4. NFPA 25
5. Requirements of the local Authority Having Jurisdiction (AHJ).
6. FM Global Datasheet 2-0.

B. Products in accordance with:

1. UL listed.
2. FM (Factory Mutual) approved.
3. Requirements of the local Authority Having Jurisdiction (AHJ).

1.8 CERTIFICATE OF TESTING

A. Furnish the Owner with test certificate certifying the system approved by:

1. Fire Marshal
2. Insurance Services Officials

PART 2 - PRODUCTS

2.1 GENERAL

A. Work included:

1. Design, coordination, furnishing, and installation of inside and outside piping, valves, sprinkler heads, hangers, supports, and sleeves.
2. The sprinkler system is an automatic wet pipe type system and shall be designed to provide coverage for the entire building unless specifically indicated otherwise.

    a. The Contract Drawings indicate the general extent and arrangement.
    b. The Contract Drawings identify rooms and spaces, which may aid in the determination of the various occupancy hazard classifications.
    c. Sprinkler heads are not shown.

3. The Drawings provide a preliminary layout with locations of water service entry/water supply, control valves, riser assembly/zone valves, and fire department connection(s). These are a guide for the subsequent preparation of the Licensed Fire Sprinkler Contractor's detailed working drawings.
4. Coordinate work and installation with electrical and fire alarm contractors accordingly. Ensure that power is provided at required locations. Ensure that system is interfaced with

the building fire and smoke alarm systems. This shall include, but not necessarily be limited to:

a. Flow and tamper switches - including any remote locations such as backflow preventer vaults, water supply post indicating valves, etc.
b. Waterflow signals ensure the immediate shut down of associated HVLS fans per NFPA 13, 11.1.7.
c. Heat trace pipe freeze protection system.

B. Requirements:

1. Materials and installation to meet or exceed the requirements of NFPA 13, prevailing edition and the local Authority Having Jurisdiction (AHJ).
2. All components of the system shall be UL listed for the intended service.
3. Provide components with minimum pressure ratings as suited for system working pressure(s).

2.2 VALVES

A. General requirements:

1. Valves shall be rated for no less than 175 psi.
2. All valves controlling connections to water supplies and to supply pipes to sprinklers shall be listed indicating valves.
3. Drain and test valves shall be approved.
4. All control, drain, venting, and test connection valves shall be provided with permanently marked weatherproof metal identification signs.
5. Provide as indicated on the Drawings and configured in accordance with the requirements of the local Authority Having Jurisdiction.
6. A listed relief valve not less than 1/2" in size shall be provided on each wet pipe system, in accordance with NFPA 13 requirements. Provide a piped drain line to the outdoors for each such valve.

B. Alarm Valves

1. Riser alarm valves shall be UL listed, FM approved alarm check valve type complete with pressure actuated switch or riser check valve type with a listed vane type waterflow alarm switch.

a. Approved pressure gauges shall be provided on both the supply and system sides of the valve.
b. Valve body shall include a removable cover for check clapper access.

2. Local waterflow alarm devices shall be a listed water-motor operated device or an electrified bell type for outdoor installation. Additionally, provide an electrified bell for indoor installation. System Sensor, Potter, or Reliable.
3. Provide connectivity to the building fire alarm system.
4. Acceptable valve manufacturers:

a. Reliable
b. Viking
c. Tyco-Grinnell
d. Victaulic (acceptable for alarm check valve variations only)

C. Control Valves (Gate)

1. Control valves shall be UL listed, FM approved bronze trimmed resilient wedge gate type.
2. Provide bronze bodied, rising stem, inside screw type for sizes 2" and smaller. Provide ductile iron bodied, rising stem, outside screw and yoke type for sizes 2-1/2" and larger.
3. Acceptable manufacturers:

a. Mueller Company
b. Kennedy Valve
c. Victaulic
d. Nibco

D. Control Valves (Butterfly)

1. Control valves shall be UL listed, FM approved ductile iron bodied, gear operated with flag, butterfly type.
2. Acceptable manufacturers:

a. Reliable
b. Kennedy Valve
c. Tyco-Grinnell
d. Victaulic
e. Nibco

E. Check Valves

1. Check valves shall be UL listed, FM approved ductile or cast iron bodied, bronze fitted, non-slam type, suited for horizontal or vertical installation.
2. Acceptable manufacturers:

a. Mueller Company
b. Kennedy Valve
c. Victaulic
d. Nibco
e. Tyco-Grinnell

F. Test and Drain Valve Assemblies shall be UL listed, FM approved bronze bodied ball valve type complete with tamper resistant test orifice and sight glasses. AGF Manufacturing, Inc.

G. Automatic air release valve and vent assemblies shall be UL listed, FM approved and provided complete with brass or bronze bodied ball valves, stainless steel mesh strainers, and float operated air release valves. Acceptable manufacturers:

1. Engineered Corrosion Solutions PAV-W.

2. Tyco TAV-W.
3. Potter PAAR-B.

H. Backflow Preventers: Provide as indicated on the Drawings and in accordance with the requirements of the water supplier and public health authority having jurisdiction. All such devices shall be listed for fire protection service.

2.3 PIPE AND FITTINGS

A. Underground service entry shall be UL listed, FM approved, NFPA 24 compliant, type 304 stainless steel, pre-fabricated in-building riser. Acceptable manufacturers:

1. Ames Fire & Waterworks
2. Zurn Wilkins

B. All sprinkler system piping above grade shall be (refer to 210000 for **standpipe** system piping):

1. ASTM A135/A135M / ASTM A53/A53M schedule 10 black steel pipe with roll-grooved ends, joined with mechanical couplings and with manufactured carbon steel grooved fittings with matching mechanical couplings for pipe 2-1/2" and larger. Fittings shall be fully metallically formed type with an independent gasket and coupling at each pipe connection. All coupling assembly points shall have bolts and nuts.
2. ASTM A135/A135M / ASTM A795/A795M schedule 40 black steel threaded pipe and cast iron or malleable iron fittings for pipe 2" and smaller.
3. For gridded systems, the use of an approved grooved mechanical coupling shall be acceptable at one end of each branch line to facilitate the connection of such branch lines to a system main.
4. Welding shall be acceptable only for providing ASTM A53/A53M shop welded, branch outlet fittings, UL Listed and FM Approved for use in fire sprinkler systems, in accordance with NFPA 13 and local AHJ requirements.

    a. Merit Manufacturing Corporation or pre-approved equal.
    b. In no case shall butt-welding of pipe ends be allowed.

C. Acceptable manufacturers:

1. Wheatland Tube Company
2. Bull Moose Tube Company
3. Tex-Tube
4. Allied Tube

D. Acceptable mechanical coupling manufacturers:

1. Victaulic
2. Tyco-Grinnell
3. Anvil Gruvlok

E. Regardless of manufacturer, the use of pipe hole-cut, gasketed bolt-on branch outlets shall not be permitted. This prohibition includes, but is not necessarily limited to, the following: clamp-T, mechanical-T, outlet-T, strap-T, and U-bolt-T outlet connectors.

F. In all locations subject to corrosive conditions, ensure to provide a suitable epoxy (spray) coating to all exposed surfaces of pipe and fittings. Such locations shall include, but not necessarily be limited to, the following: natatoriums, pool equipment rooms, chemical and metal process areas, and animal pens. All job-applied protective coatings shall be provided as approved and only after verification that the proper piping has been installed, per the markings along the length of the pipe.

2.4 SPRINKLER HEADS

A. Suspended Ceiling Type: Standard concealed pendent type with white cover plate.

B. Exposed Area Type: Standard upright type with brass finish.

C. Sidewall Type: Chrome plated finish with matching escutcheon.

D. Where maximum ceiling temperatures exceed 100 degrees F, sprinklers with temperature ratings in accordance with maximum ceiling temperatures as tabulated in NFPA 13 shall be provided.

1. Sprinkler heads within a given compartment must all be of the same temperature rating. Ambient ceiling temperatures expected in the vicinity of the sprinklers must be considered accordingly.
2. Possible high ambient temperature areas may include, but are not necessarily limited to, the following: electrical equipment rooms, kiln rooms, sauna rooms, interior generator rooms, skylights, and manufacturing/process spaces.

E. Sprinkler heads which utilize an “O”-ring type water seal within the sprinkler frame are not acceptable, in accordance with the latest UL requirements for sprinkler head design.

F. In all locations subject to corrosive conditions provide heads entirely constructed of stainless steel or heads with polyester coated finish and dipped in wax. Such locations shall include, but not necessarily be limited to, the following: natatoriums, pool equipment rooms, chemical and metal process areas, and animal pens.

G. In all locations subject to occupant abuse or vandalism provide institutional type sprinkler heads with tamper-resistant construction and suitable “break-away” weight test documentation from the manufacturer. Such locations shall include, but not necessarily be limited to, the following: patient areas of institutional mental health occupancies, prisoner areas (cells, etc.) of correctional facilities – jails, prisons, juvenile detention facilities.

H. Flexible type sprinkler head connections are acceptable only in accessible ceilings, all hard ceilings shall have rigid concealed type heads.

I. Acceptable manufacturers:

1. Tyco-Grinnell
2. Viking
3. Victaulic
4. Reliable
5. Globe Fire Sprinkler Corporation

2.5 FIRE DEPARTMENT CONNECTIONS

A. Refer to Section 210000 for all such requirements.

2.6 INSULATION AND HEAT TRACING

A. Provide a supervised, listed (UL 515A) pipe freeze protection system, complete with insulation, for all water-filled pipe, fittings, and valves subject to freezing conditions. The system shall be designed to maintain water temperature at a minimum of 40 degrees F.

B. Heat trace cable shall be self-regulating type with a cross-linked polymer core, tinned copper braid, and a polyolefin outer jacket. Cable, power connections, splices/tees, end seals, temperature sensors, controllers, and other system appurtenances shall be the product of single heat trace system manufacturer and provided in strict accordance with the manufacturer's recommendations. nVent/Raychem XL-Trace Edge System or pre-approved equal.

C. A UL listed closed cell flame-retardant thermal insulation protected with weatherproof cladding (aluminum jacketing with sealed joints) shall be provided. 1-1/2" phenolic foam with a density of no less than 2.5 pounds per cubic foot. Provide with factory applied ASJ varpor retarder jacket for indoor applications and zero perm vapor barrier for outdoors applications. Resolco, Inc. Insul-Phen or pre-approved equal.

PART 3 - EXECUTION

3.1 GENERAL

A. All equipment shall be installed in accordance with the manufacturer’s recommendations and printed installation instructions.

B. All items required for a complete and proper installation are not necessarily indicated on the plans or in the specifications. Provide all items as required by NFPA 13 and installed as per manufacturer’s recommendations.

C. For any area requiring sprinkler protection and where the piping will be subject to freezing, the expectation is that a dry pipe system will be provided. This shall apply whether or not such an area has been identified on the Drawings and whether or not such a system has been specified under a separate Section.

D. Dry-type sprinklers shall be used in all coolers and freezers.

3.2 DESIGN

A. Design spacing of sprinkler heads and selection sizes shall conform to the requirements of NFPA 13 for the occupancy hazard.

B. Uniform discharge density design shall be based on hydraulic calculations utilizing the method outlined in NFPA 13. Density of discharge from sprinkler heads shall conform to NFPA 13.

C. Friction losses in pipe will be based on a value of "C" =120 in the Hazen - Williams formula for steel pipe and "C" =150 for listed CPVC pipe (only if specified).

D. Design and install the system so that no part will interfere with doors, windows, heating, plumbing, or electrical equipment. Do not locate sprinkler heads within 6 inches of lighting fixtures, HVAC diffusers and other obstructions. Sprinkler piping cannot penetrate ductwork, structural members, or lighting fixtures.

E. The Contractor shall conform to NFPA 13, prevailing edition. Special attention shall be given to the Chapters on Plans and Calculations and on Systems Acceptance. It shall be the Licensed Fire Sprinkler Contractor’s responsibility to determine if any deficiencies exist, such as an inadequate water supply, or any other item which would materially affect the acceptability of the system.

F. Design sprinkler system piping accordingly and provide hose connections complete with valves, hoses, and cabinets where and as required by code. Adhere to the acceptable manufacturers listed in Section 210000. Locations shall include, but are not necessarily limited to, the following: theatrical stages greater than 1,000 square feet.

G. Reference the latest architectural reflected ceiling plans. Extend branch lines accordingly to provide sprinklers both above and below “cloud” ceilings, where present and as required.

H. Ensure to provide sprinklers under fixed obstructions (such as ductwork) over 48 inches wide.

3.3 INSTALLATION - GENERAL

A. Install all items in accordance with applicable codes.

B. Install piping so that mains and branches are not located directly underneath HVAC equipment or other items needing access.

C. Do not install risers or mains in MDF/IDF/Data closets or electrical rooms. Where sprinkler protection is provided, only the associated branch lines and sprinkler heads shall be allowed in such spaces.

D. Furnish additional heads which may be required for coordinated ceiling patterns without added cost, even though number of heads may exceed minimum code requirements.

E. All sprinkler heads shall be located as near the center of ceiling tiles as is practical (±1/2”). Location shall present a uniform pattern with all heads aligned when completely installed.

F. Run piping concealed above furred ceilings and in joist space to minimize obstructions. Expose only heads. Exact routing of piping shall be approved by Architect or relocated as required at no additional cost to Owner.

G. Provide wire guards on all non-concealed pendent and upright sprinklers heads subject to damage, including, but not necessarily limited to, the following locations: coolers, freezers, under stairwells, mechanical rooms, gymnasiums, athletic areas, wood, and metal shops.

H. Locate outside alarms on wall of building adjacent to sprinkler riser room.

I. Provide on wall near the sprinkler valve(s): a clearly labeled and suitably sized cabinet containing (a minimum of 5% but no less than four) spare sprinkler heads of each type and a wrench suitable for each head type.

J. Provide one case of spare escutcheons for each type of sprinkler head.

K. Provide 1 inch diameter nipple and 1 inch x 1/2 inch reducing fitting for each upright head.

3.4 INSTALLATION - DRAINAGE

A. All sprinkler pipe and fittings shall be installed so that the system can be drained.

B. Unless not practicable, all piping shall be arranged to drain to the main drain valve for each sprinkler system. Make provisions accordingly for any trapped piping and provide auxiliary drains as necessary, complete with signage, and in accordance with NFPA 13 requirements.

C. Unless noted otherwise on the Drawings or in conflict with Owner requirements, all drains shall discharge to the outdoors at locations free from the possibility of causing water damage. Each such drain shall be provided with a chrome wall escutcheon and 45 degree galvanized ell turned down.

3.5 INSTALLATION - AIR VENTS

A. Each system shall be provided with at least one (1) automatic air vent, however more than one (1) may be required on a given system in order to exhaust the trapped air.

B. Each air vent shall be located near a high point in the system it serves. Provide each such vent where it will be most effective and locate it off the top of the horizontal piping in an accessible location and a level position.

3.6 SYSTEM IDENTIFICATION

A. Provide a printed sheet giving brief instructions relative to all necessary aspects of sprinkler controls and emergency procedures next to sprinkler riser mains. Instruction sheet shall be laminated or protected by a transparent plastic cover.

B. Provide laminated zone map(s) at the riser location(s) clearly indicating the geographical area protected by each zone valve/floor control assembly. Floor plan shall include the locations of all valves (marked and labeled).

C. Provide an additional laminated map as described above at the fire alarm control panel.

D. All hydraulic calculation plates must be engraved.

E. Each system valve (indoor and outdoor) must be permanently labeled with the system information.

F. Signage:

1. Each riser room door must have a 2'-0" x 3'-0" sign provided on the outside with the wording "SPRINKLER RISER ROOM."
2. Each fire department connection shall have a sign with the street address on it.
3. Signage provided shall comply with NFPA and local AHJ requirements.

3.7 PAINTING AND PIPE IDENTIFICATION

A. Refer to Section 210000 for all such requirements.

3.8 REPLACEMENT

A. Upon receipt of written notice of failure of any part of the guaranteed equipment during the guaranteed period, the Contractor will replace the affected part or parts promptly at no additional cost.

3.9 TESTING

A. Prior to testing, the entire sprinkler system shall be thoroughly flushed clean.

B. Upon completion of the installation and flushing, test the system and obtain approval of the local fire insurance rating organization having jurisdiction. Particular attention is called to the acceptance requirements of NFPA 13.

C. Testing and acceptance must be provided for underground and aboveground piping per NFPA 13 and local AHJ requirements. Documentation of such shall be provided to the Owner.

D. The owners engineer shall be notified and shall witness all flushing, cleaning, and testing of the fire sprinkler system.

3.10 TRAINING

A. The Owner's maintenance staff shall be fully briefed in the normal start-up of the system, operation, normal and emergency shutdown, and maintenance of the system.

B. Routine maintenance, yearly maintenance, and any seasonal requirements or considerations shall be fully discussed and documented.

C. Names of those instructed and dates, as well as a list of information provided to the Owner shall be included in the final report.

END OF SECTION 211313

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SECTION 220200 - BASIC MATERIALS AND METHODS FOR PLUMBING

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all Work herein.

B. The Contract Drawings indicate the extent and general arrangement of the systems. If any departure from the Contract Drawings is deemed necessary by the Contractor, details of such departure and the reasons therefore shall be submitted to the Architect/Engineer for approval as soon as reasonably practicable. No such departures shall be made without the prior written approval of the Architect/Engineer.

C. Notwithstanding any reference in the Specifications to any article, device, product, material, fixture, form or type of construction by name, make or catalog number, such reference shall not be construed as limiting competition; and the Contractor, in such cases, may at his option use any article, device, product, material, fixture, form or type of construction which in the judgment of the Architect/Engineer, expressed in writing, is equal to that specified.

1.2 SCOPE OF WORK

A. The Work included under this Contract consists of the furnishing and installation of all equipment and material necessary and required to form the complete and functioning systems in all of their various phases, all as shown on the accompanying Drawings and/or described in these Specifications. The Contractor shall review all pertinent Drawings, including those of other contracts, prior to commencement of Work.

B. This Division requires the furnishing and installing of all items as specified herein, indicated on the Drawings, or reasonably inferred as necessary for safe and proper operation; including every article, device or accessory (whether or not specifically called for by item) reasonably necessary to facilitate each system's functioning as indicated by the design and the equipment specified. Elements of the work include, but are not limited to materials, labor, supervision, transportation, storage, equipment, utilities, all required permits, licenses, and inspections. All work performed under this Section shall be in accordance with the Project Manual, Drawings and Specifications and is subject to the terms and conditions of the Contract.

C. The approximate locations of Plumbing and Fire Protection items are indicated on the Drawings. These Drawings are not intended to give complete and accurate details with regards to locations of piping, appurtenances, etc. Exact locations are to be determined by actual measurements at the building/job-site and will in all cases be subject to the Review of the Owner or Engineer, who reserves the right to make any reasonable changes in the locations indicated without additional cost to the Owner.

D. 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.

E. All discrepancies between the Contract Documents and actual job-site conditions shall be reported to the Owner or Engineer so that they will be resolved prior to bidding. Where this cannot be done at least seven (7) working days prior to bid; the greater or more costly of the discrepancy shall be bid. All labor and materials required to perform the work described shall be included as part of this Contract.

F. It is the intention of this Section of the specifications to outline minimum requirements to furnish the Owner with a turn-key and fully operating system in cooperation with other trades.

G. It is the intent of the above "Scope" to give the Contractor a general outline of the extent of the Work involved; however, it is not intended to include each and every item required for the Work. Anything omitted from the "Scope" but shown on the Drawings, or specified elsewhere, or necessary for complete and functioning plumbing systems shall be considered a part of the overall "Scope".

H. The Contractor shall rough-in fixtures and equipment furnished by others from rough-in and placement drawings furnished by others. The Contractor shall make final connection to fixtures and equipment furnished by others.

I. The Contractor shall participate in the Commissioning process as required; including, but not necessarily limited to: meeting attendance, completion of checklists, and participation in functional testing.

1.3 SCHEMATIC NATURE OF CONTRACT DOCUMENTS

A. 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 reviewed Shop Drawings.

B. The piping, fixture, and equipment locations as indicated on the documents do not indicate every transition, offset, or exact location. All transitions, offsets, clearances, and exact locations shall be established by actual field measurements, coordination with the structural, architectural, and reflected ceiling plans, and other trades. Submit Shop Drawings for review.

C. All transitions, offsets and relocations as required by actual field conditions shall be provided by the Contractor at no additional cost to the owner.

D. Additional coordination with Electrical Subcontractor may be required to allow adequate clearances of electrical equipment, fixtures, and associated appurtenances. Contractor to notify Architect and Engineer of unresolved clearances, conflicts, or equipment locations.

1.4 SITE VISIT AND FAMILIARIZATION

A. Before submitting a bid, it will be necessary for each Contractor whose work is involved to visit the site and ascertain for himself the conditions to be met therein in installing his work and make due provision for same in his bid. It will be assumed that this Contractor in submitting his bid has visited the premises and that his bid covers all work necessary to properly install the piping, fixtures and equipment shown. Failure on the part of the Contractor to comply with this requirement shall not be considered justification for the omission or faulty installation of any work covered by these Specifications and Drawings.

B. Understand the existing utilities from which services will be supplied; verify locations of utility services and determine requirements for connections.

C. Determine in advance that equipment and materials proposed for installation fit into the confines indicated.

1.5 WORK SPECIFIED IN OTHER SECTIONS

A. Finish painting is specified elsewhere. Prime and protective painting is included in the work of this Division.

B. Owner and General Contractor furnished equipment shall be properly connected to plumbing systems.

C. Furnishing and installing all required plumbing equipment, control relays and electrical interlock devices, conduit, wire, and junction boxes are included in the Work of this Division.

1.6 PERMITS, TESTS, INSPECTIONS

A. Arrange and pay for all permits, fees, tests, and all inspections as required by government authorities.

1.7 DATE OF 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 the date final payment has been received. Refer to Division 01 for additional requirements.

B. The date of final acceptance shall be documented in writing and signed by the Architect, Owner, and Contractor.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to the project properly identified with names, model numbers, types, grades, compliance labels, and other information needed for identification.

B. Deliver products to the project at such times as the project is ready to receive the fixtures, equipment, pipe, valves, etc. - properly protected from incidental damage and weather damage.

C. Damaged fixtures, equipment, valves, pipe, or appurtenances shall be promptly removed from the site and new, undamaged items shall be provided in its place promptly with no additional charge to the Owner.

1.9 NOISE AND VIBRATION

A. The plumbing systems and the component parts thereof shall be guaranteed to operate without objectionable noise, water hammering, and vibration.

B. Provide foundations, supports and isolators as specified or indicated, properly adjusted to prevent transmission of vibration to the building structure, piping, and other items.

C. Carefully fabricate pipe and fittings with smooth interior finish to prevent turbulence and generation or regeneration of noise.

D. All equipment shall be selected to operate with minimum noise and vibration. If, in the opinion of the Architect/Engineer, objectionable noise or vibration is produced or transmitted to or through the building structure by equipment, piping or other parts of the Work, the Contractor shall rectify such conditions without extra cost to the Owner.

E. Above ceiling piping and valves shall not be installed in direct contact with the work of other trades, including, but not limited to, suspended ceiling hanger wire.

1.10 APPLICABLE CODES

A. Obtain all required permits and inspections for all work required by the Contract Documents and pay all required fees in connection thereof.

B. Arrange with the serving utility companies for the connection, relocation, and upgrade of all required utilities and pay all charges, meter charges, connection fees and inspection fees, if required.

C. Comply with all applicable codes, specifications, local ordinances, industry standards, utility company regulations and the applicable requirements of the nationally accepted codes and standards.

D. Such codes and standards shall include, but not necessarily be limited to:

1. American Standards Association, ASA.
2. American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc., ASHRAE.
3. American Society of Mechanical Engineers, ASME.
4. American Society of Plumbing Engineers, ASPE.
5. American Society of Testing Materials, ASTM.
6. American Water Works Association, AWWA.

7. National Bureau of Standards, NBS.
8. National Fire Protection Association, NFPA.
9. UL, LLC (formerly Underwriters Laboratories).
10. FM Global.
11. International Energy Conservation Code, IECC.
12. International Fire Code.
13. International Fuel Gas Code.
14. International Plumbing Code.

E. Where differences exist between the Contract Documents and applicable state or city building codes, state and local ordinances, industry standards, utility company regulations and the applicable requirements of the above listed nationally accepted codes and standards, the more stringent or costly application shall govern. Promptly notify the Architect/Engineer in writing of all differences.

F. When directed in writing by the Architect/Engineer, remove all work installed that does not comply with the Contract Documents and applicable state or city building codes, state and local ordinances, industry standards, utility company regulations and the applicable requirements of the above listed nationally accepted codes and standards. Correct the deficiencies and complete the work at no additional cost to the Owner.

1.11 DEFINITIONS AND SYMBOLS

A. General Explanation: A substantial amount of construction and Specification language constitutes definitions for terms found in other Contract Documents, including Drawings which must be recognized as diagrammatic and schematic in nature and not completely descriptive of requirements indicated thereon. Certain terms used in Contract Documents are defined generally in this article, unless defined otherwise in Division 01.

B. Definitions and explanations of this Section are not necessarily either complete or exclusive but are general for work to the extent not stated more explicitly in another provision of the Contract Documents.

C. Indicated: The term "Indicated" is a cross-reference to details, notes, or schedules on the Drawings, to other paragraphs or schedules in the Specifications and to similar means of recording requirements in Contract Documents. Where such terms as "Shown", "Noted", "Scheduled", "Specified" and "Detailed" are used in lieu of "Indicated", it is for the purpose of helping the reader locate cross-reference material, and no limitation of location is intended except as specifically shown.

D. Directed: Where not otherwise explained, terms such as "Directed", "Requested", "Accepted", and "Permitted" mean by the Architect or Engineer. However, no such implied meaning will be interpreted to extend the Architect's or Engineer's responsibility into the Contractor's area of construction supervision.

E. Reviewed: Where used in conjunction with the Engineer's response to submittals, requests for information, applications, inquiries, reports and claims by the Contractor the meaning of the term "Reviewed" will be held to limitations of Architect's and Engineer's responsibilities and duties as specified in the General and Supplemental Conditions. In no case will "Reviewed" by

Engineer be interpreted as a release of the Contractor from responsibility to fulfill the terms and requirements of the Contract Documents.

F. Furnish: Except as otherwise defined in greater detail, the term "Furnish" is used to mean supply and deliver new to the project site, ready for unloading, unpacking, assembly, installation, etc., as applicable in each instance.

G. Install: Except as otherwise defined in greater detail, the term "Install" is used to describe operations at the project site including unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protection, cleaning and similar operations, as applicable in each instance.

H. Provide: Except as otherwise defined in greater detail, the term "Provide" is used to mean "Furnish and Install", complete and ready for intended use, as applicable in each instance.

I. Installer: Entity (person or firm) engaged by the Contractor or its Subcontractor for performance of a particular unit of work at the project site, including unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protection, cleaning and similar operations, as applicable in each instance. It is a general requirement that such entities (Installers) be expert in the operations they are engaged to perform.

J. Imperative Language: Used generally in Specifications. Except as otherwise indicated, requirements expressed imperatively are to be performed by the Contractor. For clarity of reading at certain locations, contrasting subjective language is used to describe responsibilities that must be fulfilled indirectly by the Contractor, or when noted by other identified installers or entities.

K. Minimum Quality/Quantity: In every instance, the quality level or quantity shown or specified is intended as minimum quality level or quantity of work to be performed or provided. Except as otherwise specifically indicated, the actual work may either comply exactly with that minimum (within specified tolerances) or may exceed that minimum within reasonable tolerance limits. In complying with requirements, indicated or scheduled numeric values are either minimums or maximums as noted or as appropriate for the context of the requirements. Refer instances of uncertainty to Owner or Engineer via a request for information (RFI) for decision before proceeding.

L. Abbreviations and Symbols: The language of Specifications and other Contract Documents including Drawings is of an abbreviated type in certain instances and implies words and meanings which will be appropriately interpreted. Actual word abbreviations of a self-explanatory nature have been included in text of Specifications and Drawings. Specific abbreviations and symbols 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 or on a Legend and Symbol Drawing. Trade and industry association names and titles of generally recognized industry 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 Contract Documents so indicate. Except as otherwise indicated, graphic symbols and abbreviations used on Drawings and in Specifications are those recognized in construction industry for indicated purposes. Where not otherwise noted symbols and abbreviations are

defined by 2009 ASHRAE Fundamentals Handbook, chapter 34 "Abbreviations and Symbols", ASME and ASPE published standards.

1.12 DRAWINGS AND SPECIFICATIONS

A. These Specifications are intended to supplement the Drawings. It will not be the province of the Specifications to address any part of the work which the Drawings can fully convey in every particular and such omission shall not relieve the Contractor from carrying out portions of work indicated on the Drawings only.

B. Should items be required by these Specifications and not indicated on the Drawings, they are to be supplied even if of such nature that they could have been indicated thereon. In case of disagreement between Drawings and Specifications, or within either Drawings or Specifications, the better quality or greater quantity of work shall be estimated and the matter referred to the Architect or Engineer for review with a request for information and clarification at least seven (7) working days prior to bid opening date for issuance of an addendum.

C. The listing of product manufacturers, materials, and methods in the various sections of the Specifications, and indicated in the Drawings, is intended to establish a standard of quality only. It is not the intention of the Owner or Engineer to discriminate against any product, material or method that is equal to the standards as indicated and/or specified, nor is it intended to preclude open, competitive bidding. The fact that a specific manufacturer is listed as an acceptable manufacturer should not be interpreted to mean that the manufacturers' standard product will meet the requirements of the project design, Drawings, Specifications, and space constraints.

D. The Architect or Engineer and Owner shall be the sole judge of quality and equivalence of equipment, materials, and methods.

E. Products by other reliable manufacturers, other materials, and other methods, will be accepted as outlined, provided they have equal capacity, construction, and performance. However, under no circumstances shall any substitution by made without the written permission of the Architect or Engineer and Owner. Request for prior approval must be made in writing at least ten (10) days prior to the bid date without fail.

F. Wherever a definite product, material or method is specified and there is not a statement that another product, material or method will be acceptable, it is the intention of the Owner or Engineer that the specified product, material or method is the only one that shall be used without prior approval.

G. Wherever a definite material or manufacturer's product is specified and the Specification indicates that products of similar design and equal construction from the list of acceptable manufacturers may be used, it is the intention of the Owner or Engineer that products of manufacturers that are specified are the only products that will be acceptable and that products of other manufacturers will not be considered for substitution without approval.

H. Wherever a definite product, material or method is specified and there is a statement that "OR EQUAL" product, material or method will be acceptable, it is the intention of the Owner or Engineer that the specified product, material or method or an "OR EQUAL" product, material

or method may be used if it complies with the specifications and is submitted for review to the Engineer as outlined herein.

I. Where equipment other than that used in the design as specified or shown on the Drawings is provided (either from an acceptable manufacturer list or by submittal review), it shall be the responsibility of the Contractor to coordinate space requirements, building provisions and connection requirements with all trades bear any additional costs.

J. Where permission to use a substitution product, material, or method is granted by the Owner or Engineer in writing, the Contractor shall bear full responsibility for the implementation of that substitution. Specific responsibilities shall include, but shall not be limited to, the following:

1. Verifying that the substituted item will fit in the space available. This shall include allowances for all code required clearances and manufacturer's maintenance and service clearances.
2. The coordination and provision of all necessary supports, hangers, and appurtenances. Hanger spacing shall be adjusted accordingly and any additional hangers or supports required shall be provided.
3. The coordination and provision of all necessary insulation, firestopping provisions, etc.
4. Adherence to manufacturer's published installation recommendations.
5. Adherence to requirements of the Authority Having Jurisdiction (AHJ) and provision of a code compliant installation.
6. Changes to architectural, structural, electrical, mechanical, and plumbing requirements as a result of the substitution.
7. Bearing any additional costs and time impact and providing any necessary redesign. The Owner will bear no such cost and make no time allowances.
8. Coordination of plumbing and electrical requirements and utility provisions with the Mechanical and Plumbing Design Documents and all other trades, including Division 26.

K. If any request for a substitution of product, material or method is rejected, the Contractor will automatically be required to furnish the product, material or method named in the Specifications. Repetitive requests for substitutions will not be considered.

L. The Owner or Engineer will investigate all requests for substitutions when submitted in accordance with above and if accepted, will issue a written acceptance allowing the substitutions.

1.13 SUBMITTALS

A. Coordinate with Division 01 for submittal timetable requirements, unless noted otherwise within thirty (30) days after the Contract is awarded. The Contractor shall submit an electronic copy of a complete set of Shop Drawings and complete data covering each item of equipment or material. The submittal of each item requiring a submittal must be received by the Architect or Engineer within the above thirty (30) day period. The Architect or Engineer shall not be responsible for any delays or costs incurred due to excessive Shop Drawing review time for submittals received after the thirty (30) day time limit. The Architect and Engineer will retain a copy of all Shop Drawings for their files. All literature pertaining to items subject to Shop Drawing submittal shall be submitted at one time. Submittals shall be placed in one electronic file in PDF 8.0 format and bookmarked for individual specification sections. Individual

electronic files of submittals for individual specifications shall not be permitted. Each submittal shall include the following items:

1. A cover sheet with the names and addresses of the Project, Architect, MEP Engineer, General Contractor, and the Subcontractor making the submittal. The cover sheet shall also contain the section number covering the item or items submitted and the item nomenclature or description.
2. An index page with a listing of all data included in the Submittal.
3. A list of variations page with a listing all variations, including unfurnished or additional required accessories, items, or other features, between the submitted equipment and the specified equipment. If there are no variations, then this page shall state "NO VARIATIONS". Where variations affect the work of other Contractors, then the Contractor shall certify on this page that these variations have been fully coordinated with the affected Contractors and that all expenses associated with the variations will be paid by the submitting Contractor. This page will be signed by the submitting Contractor.
4. Equipment information including manufacturer's name and designation, size, performance, and capacity data as applicable. All applicable Listings, Labels, Approvals and Standards shall be clearly indicated.
5. Dimensional data and scaled drawings as applicable to show that the submitted equipment will fit the space available with all required Code and maintenance clearances clearly indicated and labeled at a minimum scale of 1/4" = 1'-0", as required to demonstrate that the alternate or substituted product will fit in the space available.
6. Identification of each item of material or equipment matching that indicated on the Drawings.
7. Sufficient pictorial, descriptive and diagrammatic data on each item to show its conformance with the Drawings and Specifications. Any options or special requirements or accessories shall be so indicated. All applicable information shall be clearly indicated with arrows or another approved method.
8. Additional information as required in other Sections of this Division.
9. Certification by the General Contractor and Subcontractor that the material submitted is in accordance with the Drawings and Specifications, signed and dated in long hand. Submittals that do not comply with the above requirements shall be returned to the Contractor and shall be marked "REVISE AND RESUBMIT".

B. Refer to Division 00 and Division 01 for additional information on Shop Drawings and submittals.

C. Equipment and materials submittals and Shop Drawings will be reviewed for compliance with design concept only. It will be assumed that the submitting Contractor has verified that all items submitted can be installed in the space allotted. Review of Shop Drawings and submittals shall not be considered as a verification or guarantee of measurements or building conditions.

D. Where Shop Drawings and submittals are marked "REVIEWED", the review of the submittal does not indicate that submittals have been checked in detail nor does it in any way relieve the Contractor from his responsibility to furnish material and perform work as required by the Contract Documents.

E. Shop Drawings shall be reviewed and returned to the Contractor with one of the following categories indicated:

1. REVIEWED: Contractor need take no further submittal action, shall include this submittal in the O&M manual and may order the equipment submitted on.
2. REVIEWED AS NOTED: Contractor shall submit a letter verifying that required exceptions to the submittal have been received and complied with including additional accessories or coordination action as noted and shall include this submittal and compliance letter in the O&M manual. The Contractor may order the equipment submitted on at the time of the returned submittal providing the Contractor complies with the exceptions noted.
3. NOT APPROVED: Contractor shall resubmit new submittal on material, equipment, or method of installation when the alternate or substitute is not approved, the Contractor will automatically be required to furnish the product, material or method named in the Specifications and/or Drawings. Contractor shall not order equipment that is not approved. Repetitive requests for substitutions will not be considered.
4. REVISE AND RESUBMIT: Contractor shall resubmit new submittal on material, equipment or method of installation when the alternate or substitute is marked revise and resubmit, the Contractor will automatically be required to furnish the product, material or method named in the Specifications and/or provide as noted on previous Shop Drawings. Contractor shall not order equipment marked revise and resubmit. Repetitive requests for substitutions will not be considered.
5. CONTRACTOR'S CERTIFICATION REQUIRED: Contractor shall resubmit submittal on material, equipment or method of installation. The Contractor's stamp is required stating the submittal meets all conditions of the contract documents. The stamp shall be signed by the General Contractor. The submittal will not be reviewed if the stamp is not placed and signed on all Shop Drawings.
6. MANUFACTURER NOT AS SPECIFIED: Contractor shall resubmit new submittal on material, equipment, or method of installation when the alternate or substitute is marked manufacturer not as specified, the Contractor will automatically be required to furnish the product, material or method named in the specifications. Contractor shall not order equipment where submittal is marked manufacturer not as specified. Repetitive requests for substitutions will not be considered.

F. Materials and equipment which are purchased or installed without Shop Drawing review shall be at the risk of the Contractor and the cost for removal and replacement of such materials and equipment and related work which is judged unsatisfactory by the Owner or Engineer for any reason shall be at the expense of the Contractor. The responsible Contractor shall remove the material and equipment noted above and replace with specified equipment or material at his own expense when directed in writing by the Architect or Engineer.

G. Shop Drawing Submittals shall be complete and checked prior to submission to the Engineer for review.

H. Submittals are required for, but not necessarily limited to, the following items:

1. Basic Materials.
2. Plumbing Fixtures and Valves.
3. Supports and Carriers.
4. Floor Drains, Roof Drains, and Cleanouts.
5. Interceptors/Traps (All Types).
6. Water Heaters and Boilers.
7. Expansion Tanks.

8. Water Softeners.
9. Water Treatment Equipment.
10. Water Filters.
11. Domestic Water Booster Pumps.
12. Fire Pumps and Jockey Pumps.
13. Storm, Sanitary, and Wastewater Pumps and Ejectors.
14. Fire Pump and Jockey Pump Controllers.
15. Domestic Water and Fire Protection Break Tanks.
16. Backflow Preventers.
17. Plumbing Piping.
18. Piping, Vessel, and Equipment Insulation.
19. Air Compressors and Air Dryers.
20. Expansion Fittings and Devices.
21. Variable Frequency Drives.
22. Noise and Vibration Controls.
23. Pipe and Equipment Hangers and Supports.
24. Plumbing Specialties.
25. Test, Adjust and Balance Reports.
26. Testing, Adjusting and Balancing Contractor Qualifications.
27. Coordination Drawings.

I. Refer to other Division 22 sections for additional Shop Drawing and submittal requirements. Provide samples of actual materials and/or equipment to be used on the Project upon request of the Owner or Engineer.

1.14 COORDINATION DRAWINGS

A. Prepare coordination drawings to a scale of 1/4"=1'-0" or larger; detailing major elements, components, and systems of plumbing equipment and materials in relationship with other systems, installations, and building components. Indicate locations where space is limited for installation and access and where sequencing and coordination of installations are of importance to the efficient flow of the Work, including (but not necessarily limited to) the following:

1. Indicate the proposed locations of pipe, equipment, and other materials. Include the following:

a. Wall locations and types.
b. Clearances for installing and maintaining insulation.
c. Locations of light fixtures and sprinkler heads.
d. Clearances for servicing and maintaining equipment, including tube removal and space for equipment disassembly required for periodic maintenance.
e. Equipment connections and support details.
f. Exterior wall and foundation penetrations.
g. Routing of storm, sanitary sewer piping and plumbing piping.
h. Fire-rated wall and floor penetrations.
i. Sizes and location required concrete pads and bases.
j. Valve stem movement.
k. Structural floor, wall and roof opening sizes and details.

2. Indicate scheduling, sequencing, movement, and positioning of large equipment into the building during construction.
3. Prepare floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.

B. This Contractor shall be responsible for coordination of all items that will affect the installation of the work of this Division. This coordination shall include, but not be limited to: voltage, ampacity, capacity, electrical and piping connections, space requirements, sequence of construction, building requirements and special conditions.

C. By submitting Shop Drawings on the project, this Contractor is indicating that all necessary coordination has been completed and that the systems, products and equipment submitted can be installed in the building and will operate as specified and intended, in full coordination with all other Contractors and Subcontractors.

1.15 RECORD DOCUMENTS

A. Prepare Record Documents in accordance with the requirements of Division 00 and Division 01, in addition to the requirements specified in Division 22.

B. The Contractor shall maintain a separate set of clearly and legibly marked Record Drawings on the job site to record all changes and modifications, including, but not limited to the following: work details, alterations to meet site conditions, and changes made by "Change Order" notices. Mark the drawings with colored pencil(s). These shall be available for review by the Owner, Architect or Engineer during the entire construction stage.

C. The Record Drawings shall be updated concurrently as construction progresses, and in no case less frequently than a daily basis. They shall indicate accurate dimensions for all buried or concealed work; precise locations of all concealed pipe; locations of all valves, controls, and operable devices; and any deviations from the work shown on the Construction Documents. All dimensions shall include at least two dimensions to permanent structure points.

D. Record Drawings shall indicate, at a minimum, the following installed conditions:

1. Mains and branches of piping systems, with valves and control devices located and numbered, unions located, and with items requiring maintenance located (i.e., traps, strainers, expansion fittings, tanks, etc.). Valve location diagrams, complete with valve tag chart. Indicate actual inverts and horizontal locations of underground piping.
2. Equipment locations (exposed and concealed), dimensioned from prominent building lines.
3. Approved substitutions, Contract Modifications, and actual equipment and materials installed.
4. Contract Modifications, actual equipment and materials installed.

E. Engage the services of a Land Surveyor or Professional Engineer registered in the state in which the project is located as specified herein to record the locations and invert elevations of underground installations.

F. If the Contractor does not keep an accurate set of Record Documents, the pay request may be altered or delayed at the request of the Architect. Delivery of Record Documents is a condition of final acceptance. Record Drawings shall be furnished in addition to Shop Drawings.

G. Upon completion of the Work, the Contractor shall submit three (3) full size sets of Record Drawing prints to the Architect or Engineer for review prior to scheduling the final inspection at the completion of the work. The drawings shall have the name(s) and seal(s) of the Engineer(s) removed or blanked out and shall be clearly marked and signed on each sheet as follows:

CERTIFIED RECORD DRAWINGS

DATE:

(NAME OF GENERAL CONTRACTOR)

BY: _____

(SIGNATURE)

(NAME OF GENERAL CONTRACTOR)

BY: _____

(SIGNATURE)

1.16 CERTIFICATIONS AND TEST REPORTS

A. Submit a detailed schedule for completion and testing of each system indicating scheduled dates for completion of system installation and outlining tests to be performed and scheduled dates for each test. This detailed completion and test schedule shall be submittal at least ninety (90) days before the projected Project completion date.

B. Test result reporting forms shall be submitted for review no later than the date of the detailed schedule submitted.

C. Submit four (4) copies of all certifications and test reports to the Architect or Engineer for review adequately in advance of completion of the Work to allow for remedial action as required to correct deficiencies discovered in equipment and systems.

D. Certifications and test reports to be submitted shall include, but not be limited to those items outlined in other Sections of Division 22.

1.17 OPERATIONS AND MAINTENANCE MANUALS

A. Prepare Operations and Maintenance manuals in accordance with the requirements of Division 01 and Division 22. In addition to the requirements of other Sections, this shall include operational, trouble-shooting, and routine maintenance information for fixtures, specialties, and equipment.

1. Identifying names, name tags, designations, and locations for all equipment.
2. Valve tag lists with valve number, type, color coding, location, and function.
3. Reviewed Shop Drawing submittals with exceptions noted compliance letter.
4. Fabrication drawings.
5. Equipment and device bulletins and data sheets clearly highlighted to show equipment installed on the project and including performance curves and data as applicable, i.e., description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and model numbers of replacement parts.
6. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions.
7. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
8. Servicing instructions and lubrication charts and schedules.
9. Equipment and motor name plate data.
10. Wiring diagrams.
11. Exploded parts views and parts lists for all equipment and devices.
12. Color coding charts for all painted equipment and conduit.
13. Location and listing of all spare parts and special keys and tools furnished to the Owner.
14. Furnish recommended lubrication schedule for all required lubrication points with listing of type and approximate amount of lubricant required.

B. Coordinate with Division 01 for Operations and Maintenance manual requirements. Unless noted otherwise, bind together in “D ring” style three-ring binders (National model no. 79-883 or equivalent). Binders shall be large enough to allow 1/4” of spare capacity. Include three (3) sets with all approved Shop Drawing submittals, fabrication drawings, bulletins, maintenance instructions, operating instructions and parts exploded views and lists for each and every piece of equipment furnished under this Specification. All sections shall be typed and indexed into sections with tabbed insertable dividers, labeled for easy reference. Utilize the individual specification section numbers shown in the Plumbing Specifications as an organization guideline. Bulletins containing information about equipment that is not installed on the project shall be properly marked up or stripped and reassembled. All pertinent information required by the Owner for proper operation and maintenance of equipment supplied by Division 22 shall be clearly and legibly set forth in memoranda that shall, likewise, be bound with bulletins.

C. In addition to the bound “hard-copy” Operation and Maintenance manuals referenced above, provide an identical electronic copy in searchable PDF format, with all sections bookmarked within the file for easy reference. Provide a USB flash drive with the final manual to the Owner.

D. Operating and Maintenance Manuals shall be turned over to the Owner or Engineer for review a minimum of fourteen (14) working days prior to the beginning of the operator training period.

E. Operating and Maintenance Manuals, which the Engineer deems incomplete, poorly organized, or otherwise unacceptable, will be rejected in writing. The Contractor will subsequently be required to again turn over Operating and Maintenance Manuals, with all deficiencies corrected, until deemed acceptable by the Engineer.

1.18 OPERATOR TRAINING

A. The Contractor shall furnish the services of factory trained specialists to instruct the Owner's operating personnel.

B. The Owner's operator training shall include a minimum of 12 hours of on- site training in three (3) shifts of four (4) hours each.

C. Before proceeding with the instruction of Owner’s 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 or she has a proper understanding of the operation and maintenance of the systems and then resubmit the signed outlines.

D. Refer to other Sections of Division 22 for additional Operator Training requirements.

1.19 FINAL COMPLETION

A. At the completion of the work, all equipment, operable appurtenances, and systems shall be tested. All faulty equipment and materials shall be repaired or replaced. Refer to other Sections of Division 22 for additional requirements.

B. Clean and adjust all fixtures, flushometers, valves and operable devices. Replace faulty or otherwise damaged parts immediately prior to final acceptance.

C. Touch up and/or refinish any scratched equipment and devices immediately prior to final acceptance. This shall be acceptable only for minor superficial scratches, the determination of which rests solely on the judgment of the Architect or Engineer.

1.20 CONTRACTOR'S GUARANTEE

A. Use of the Plumbing systems to provide temporary service during the construction period shall not be allowed without written permission from the Owner, and, if granted, shall not be cause for the warranty period to start, except as defined below.

B. Contractor shall guarantee to keep the entire installation in repair and perfect working order for a period of one (1) year after its completion and final acceptance, and shall furnish free of additional cost to the Owner all materials and labor necessary to comply with the above guarantee throughout the year beginning from the date of issue of Substantial Completion, Beneficial Occupancy by the Owner, or the Certificate of Final Payment as agreed upon by all parties.

C. This guarantee shall not include cleaning or changing filters except as required by testing, adjusting, and balancing.

D. All air compressors shall have parts and labor guarantees for a period of not less than five (5) years beyond the date of final acceptance.

E. Refer to other Sections of Division 22 for additional guarantee or warranty requirements.

1.21 TRANSFER OF ELECTRONIC FILES

A. Project documents are not intended or represented to be suitable for re-use by Architect/Owner or others on extensions of this project or on any other project. Any such re-use or modification without written verification or adaptation by Engineer, as appropriate for the specific purpose intended, will be at Architect/Owner's risk and without liability or legal exposure to Engineer or its consultants from all claims, damages, losses and expense, including attorney's fees arising out of or resulting thereof.

B. Because data stored in electric media format can deteriorate or be modified inadvertently, or otherwise without authorization of the data's creator, the party receiving the electronic files agrees that it will perform acceptance tests or procedures within sixty (60) days of receipt, after which time the receiving party shall be deemed to have accepted the data thus transferred to be acceptable. Any errors detected within the sixty (60) day acceptance period will be corrected by the party delivering the electronic files. Engineer is not responsible for maintaining documents stored in electronic media format after acceptance by the Architect/Owner.

C. When transferring documents in electronic media format, Engineer makes no representations as to the long-term compatibility, usability or readability of documents resulting from the use of software application packages, operating systems, or computer hardware differing from those used by Engineer at the beginning of the Project.

D. Any re-use or modifications will be Contractor's sole risk and without liability or legal exposure to Architect, Engineer, or any consultant.

E. The Texas Board of Architectural Examiners (TBAE) has stated that it is in violation of Texas law for persons other than the Architect of record to revise the Architectural drawings without the Architect's written consent.

1. It is agreed that "MEP" hard copy or computer-generated documents will not be issued to any other party except directly to the Architect/Owner. The Contract Documents are contractually copyrighted and cannot be used for any other project or purpose except as specifically indicated in AIA B-141 Standard Form of Agreement Between Architect and Owner.
2. If the client, Architect or Owner of the project requires electronic media for "record purposes," then AutoCAD/ Revit documents will be prepared by Engineer on electronic media such as removable memory devices, flash drives or CD's. These documents can also be submitted via file transfer protocols. AutoCAD/ Revit files will be submitted with all title block references intact to permit the end user to only view and plot the drawings. Revisions will not be permitted in this configuration.
3. At the Architect/Owner's request, Engineer will assist the Contractor in the preparation of the submittals and prepare one copy of AutoCAD/ Revit files on electronic media or submit through file transfer protocols. The electronic media will be prepared with all indicia of documents ownership removed. The electronic media will be prepared in a ".rvt" or ".dwg" format to permit the end user to revise the drawings.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Provide materials and equipment manufactured by a domestic United States manufacturer and assembled in the United States for all local and Federal Government projects. These materials and equipment shall comply with “Buy American Act.”

B. Access Doors: Provide access doors as required for access to equipment, valves, controls, cleanouts and other apparatus where concealed. Access doors shall have concealed hinges and screw driver cam locks unless indicated otherwise.

C. All access panels located in wet areas such as toilet rooms, locker rooms, shower rooms, natatoriums, kitchens, and any other wet areas shall be constructed of stainless steel.

D. Access doors shall be as follows:

1. Plastic 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.

2.2 EQUIPMENT PADS

A. Provide four (4) inch high concrete pads for indoor floor mounted equipment. Pads shall conform to the shape of the equipment with a minimum extension of six (6) inches beyond the equipment. Top and sides of pads shall be troweled to a smooth finish, equivalent to the floor. External corners shall be bull-nosed to a 3/4" radius, unless shown otherwise.

B. Provide six (6) inch high concrete pads for all exterior-mounted equipment. Pads shall conform to the shape of the equipment with a minimum extension of six (6) inches beyond the equipment. Provide a four (4) foot monolithic extension to the pad in front of the equipment for service when mounted on a non-finished area (i.e. landscape, gravel, clay, etc.) Top and sides of pads shall be troweled to a smooth finish. External corners shall be bull-nosed to a 3/4" radius, unless shown otherwise.

PART 3 - EXECUTION

3.1 ROUGH-IN

A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected via reviewed submittals.

B. Refer to equipment specifications in other Divisions (10, 11, 12, 13, 21, 22, etc.) for additional rough-in requirements as necessary and provide accordingly.

3.2 PLUMBING INSTALLATIONS

A. General: Sequence, coordinate, and integrate the various elements of plumbing and fire systems, materials, and equipment. Comply with the following requirements:

1. Coordinate plumbing and fire protection systems, equipment, and materials installation with other building components.
2. Verify all dimensions by field measurements.
3. Arrange for chases, slots, leave-outs, and other openings in building components during progress of construction to allow for plumbing installations.
4. Coordinate the installation of required supporting devices, sleeves, and pathways to be set in poured-in-place concrete and other structural components, as they are constructed.
5. Sequence, coordinate, and integrate installations of plumbing materials and equipment for efficient flow of the Work. Give particular attention to large equipment requiring positioning prior to closing in the building.
6. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible.
7. Coordinate connection of plumbing and fire protection systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.
8. Install systems, materials, and equipment to conform with architectural action markings on submittal, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the Work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, resolve conflicts and submit proposed solution to the Architect for review.
9. Install systems, materials, and equipment level and plumb, parallel, and perpendicular to other building systems and components, where installed exposed in finished spaces.
10. Install equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum interference with other installations. Extend grease fittings to an accessible location and label.
11. Install access panels or doors where valves, operable devices, and equipment are concealed behind finished surfaces. Refer to Article 2.1 of this Section and to Architectural documents for specifications and locations.
12. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.
13. Provide roof curbs for all roof mounted equipment. Coordinate with roof construction for pitched roof. Provide roof curb to match roof slope. Refer to architectural drawings and details.
14. The equipment to be furnished under this Specification shall be essentially the standard product of the manufacturer. Where two or more units of the same class of equipment are required, these units shall be products of a single manufacturer; however, the component parts of the system need not be the product of the same manufacturer.
15. The architectural and structural features of the building and the space limitations shall be considered in selection of all equipment. No equipment shall be furnished which will not suit the arrangement and space limitations indicated.
16. Lubrication: Prior to start-up, check and properly lubricate all bearings as recommended by the manufacturer.

17. Where the word "Concealed" is used in these Specifications in connection with insulating, painting, piping, valves, etc., it shall be understood to mean hidden from sight as in chases, furred spaces, or suspended ceilings. "Exposed" shall be understood to mean the opposite of concealed.
18. Identification of Plumbing Equipment:

    a. Plumbing equipment shall be identified by means of nameplates permanently attached to the equipment. Nameplates shall be engraved laminated plastic or etched metal. Shop Drawings shall include dimensions and lettering format for approval. Attachments shall be with escutcheon pins, self-tapping screws, or machine screws.
    b. Tags shall be attached to all valves, including control valves, with nonferrous chains. Tags shall be brass and at least 1-1/2 inches in diameter. Nameplate and tag symbols shall correspond to the identification symbols on the Record Drawings.

3.3 CUTTING AND PATCHING

A. Protection of Installed Work: During cutting and patching operations, protect adjacent installations.

B. Perform cutting, removal, patching, replacement/repair as required to:

1. Uncover Work to provide for installation of ill-timed Work.
2. Remove and replace defective Work.
3. Remove and replace Work not conforming to requirements of the Contract Documents.
4. Remove samples of installed Work as specified for testing.
5. Install fixtures, equipment, piping, and appurtenances in existing structures.
6. Upon written instructions from the Engineer, uncover and restore Work to provide for Engineer/Owner's observation of concealed Work, without additional cost to the Owner.
7. Patch and replace/repair existing finished surfaces and building components using new materials matching existing materials and experienced Installers. Patch finished surfaces and building components using new materials specified for the original installation and experienced Installers; refer to the materials and methods required for the surface and building components being patched; Refer to Article 1.11 DEFINITIONS AND SYMBOLS for definition of "Installer."

C. Cut, remove, and legally dispose of selected plumbing equipment, components, and materials as indicated, including but not limited to removal of plumbing piping, equipment, plumbing fixtures and trim, and other plumbing items made obsolete by the new Work.

D. Protect the structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed.

E. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas.

3.4 WORK SEQUENCE, TIMING, COORDINATION WITH OWNER, ARCHITECT AND ENGINEER

A. The Owner will cooperate with the Contractor; however, the following provisions must be observed:

1. A meeting will be held at the project site, prior to any construction, between the Owner's Representative, the General Contractor, the Subcontractors, and the Architect/Engineer to discuss Contractor's employee parking space, access, storage of equipment or materials, and use of the Owner's facilities or utilities. The Owner's decisions regarding such matters shall be final.
2. During the construction of this project, normal facility activities will continue in existing buildings until renovated areas are completed. Plumbing, fire protection, lighting, electrical, communications, heating, air conditioning, and ventilation systems will have to be maintained in service within the occupied spaces of the existing building.

B. Start-up for major plumbing and fire protection equipment shall be performed by a factory authorized technician. Such equipment shall include, but not necessarily be limited to, the following: domestic water boilers and packaged water heating systems, water softeners, ultra-pure water equipment systems, domestic water booster pumps, fire pumps, and break tank level alarm systems. Refer to other Sections of Divisions 21 and 22 for additional requirements.

3.5 DEMOLITION AND WORK WITHIN EXISTING BUILDINGS

A. In the preparation of these documents every effort has been made to show the approximate locations of, and connections to the existing piping, utilities, equipment and other apparatus related to this phase of the work. However, this Contractor shall be responsible for verifying all of the above information. This Contractor shall visit the existing site to inspect the facilities and related areas. This Contractor shall inspect and verify all details and requirements of all the Contract Documents, prior to the submission of a proposal. All discrepancies between the Contract Documents and actual job-site conditions shall be resolved by this Contractor, who shall produce drawings that shall be submitted to the Architect/Engineer for review. All labor and materials required to perform the work described shall be a part of this Contract.

B. All equipment and/or systems noted on the Drawings "To Remain" shall be inspected and tested on site to certify its working condition. A written report on the condition of all equipment to remain, including a copy of the test results and recommended remedial actions and costs shall be made by this Contractor to the Architect/Engineer for review.

C. All equipment and/or systems noted on the Drawings "To Be Removed" shall be removed including, associated pipe, supports, and hangers. Where pipe is to be capped for future or end of line use, it shall be properly tagged with its function or service appropriately identified. Where existing equipment is to be removed or relocated and has an electric motor or connection, the Electrical Contractor shall disconnect motor or connection, remove wiring to a safe point and this Contractor shall remove or relocate motor or connection along with the equipment.

D. Ensure existing piping and equipment to remain that is adjacent to and impacted by the scope of Work is properly supported, fastened, and secure.

E. During the construction and remodeling, portions of the Project shall remain in service. Construction equipment, material tools, extension cords, etc., shall be arranged so as to present minimum hazard or interruption to the occupants of the building. None of the construction work shall interfere with the proper operation of the existing facility or be so conducted as to cause harm or danger to persons on the premises. All fire exits, stairs or corridors required for proper access, circulation or exit shall remain clear of equipment, materials, or debris. The General Contractor shall maintain barricades, other separations in corridors and other spaces where work is conducted.

F. Certain work during the demolition phase of construction may require overtime, night time, or weekend shifts or temporary evacuation of the occupants. Coordinate and schedule all proposed down time with the Owner at least seventy-two (72) hours in advance in writing.

G. Any salvageable equipment as determined by the Owner, shall be delivered to the Owner, and placed in storage at the location of his choice. All other debris shall be removed from the site immediately and disposed of lawfully.

H. Equipment, piping, or other potential hazards to the working occupants of the building or the general public shall not be left overnight outside of the designated working or construction area.

I. Make every effort to minimize damage to the existing building and the Owner's property. Repair, patch, or replace as required any damage that occurs as a result of work at the site. Care shall be taken to minimize interference with the Owner's activities during construction and to keep construction disrupted areas to a minimum. Coordinate with the Owner and other trades in scheduling and performance of the work.

J. Include in the contract price all rerouting of existing pipe, utilities, etc., and the reconnecting of the existing equipment and plumbing fixtures as necessitated by field conditions to allow the installation of the new systems regardless of whether or not such rerouting, reconnecting or relocating is shown on the Drawings. Provide all temporary pipe, utilities, controls, etc., as required to maintain heating, cooling, ventilation, and plumbing services for the existing areas with a minimum of interruption.

K. All existing plumbing fixtures, pipe, utilities, materials, equipment, controls, and appurtenances not included in the remodel or alteration areas are to remain in place.

L. Pipe, utilities, equipment and controls serving mechanical, plumbing and owner's equipment, etc., which is to remain but which is served by pipe, utilities, equipment and controls that are disturbed by the remodeling work, shall be reconnected in such a manner as to leave this equipment in proper operating condition.

M. No portion of the fire protection systems shall be turned off, modified, or changed in any way without the express knowledge and written permission of the Owner’s representative in order to protect systems that shall remain in service.

N. It is the intention of this Section of the Specifications to outline minimum requirements to furnish the Owner with a turn-key and operating system in cooperation with other trades with a minimum of disruption or downtime.

O. Refer to Architectural Demolition and/or Alteration plans for actual locations of walls, ceiling, etc., being removed and/or remodeled.

END OF SECTION 220200

SECTION 220201 - COORDINATION DRAWINGS

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions 013100 and Supplementary Conditions apply to all Work herein.

1.2 COORDINATION DRAWING

A. The Contractor shall take the lead in coordinating the Mechanical, Electrical, Plumbing, Communications, Electronic Safety/Security and Fire Protection systems within the building.

B. The Contractor shall coordinate a three-dimensional (3D) model of the building which includes the Mechanical, Electrical, Plumbing, and Fire Protection systems. The Contractor will be provided with the REVIT model that was used to generate the contract documents, and this file may be used as the background file. The Contractor shall replace the systems drawn with the actual shop drawing models. The Contractor is not limited to using REVIT and may use any 3-D software in generating and combining the coordination model.

C. Submitting the contract drawings as coordination drawings will not be acceptable.

D. The model shall include detailed and accurate representations of all equipment to be installed based upon the reviewed equipment submittals.

E. The Contractor shall hold a 3-D coordination meeting with all sub-contractors present to review the model and discuss coordination of the installation of the building systems.

F. Upon completion of the coordination meeting, the Contractor shall submit the 3-D model and 1/4" scale drawings for review.

G. The model shall detail major elements, components, and systems in relationship with other systems, installations, and building components. Indicate locations where space is limited for installation and access and where sequencing and coordination of installations are of importance to the efficient flow of the Work, including (but not necessarily limited to) the following:

1. Indicate the proposed locations of pipe, duct, equipment, and other materials. Include the following:

    a. Wall and type locations.
    b. Clearances for installing and maintaining insulation.
    c. Locations of light fixtures and sprinkler heads.
    d. Clearances for servicing and maintaining equipment, including tube removal, filter removal, and space for equipment disassembly required for periodic maintenance.
    e. Equipment connections and support details.

f. Exterior wall and foundation penetrations.
g. Routing of storm and sanitary sewer piping.
h. Fire-rated wall and floor penetrations.
i. Sizes and location required concrete pads and bases.
j. Valve stem movement.
k. Structural floor, wall and roof opening sizes and details.

2. Indicate scheduling, sequencing, movement, and positioning of large equipment into the building during construction.
3. Prepare floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.
4. Prepare reflected ceiling plans to coordinate and integrate installations, air distribution devices, light fixtures, communication systems components, and other ceiling mounted items.

H. Sequence of Coordination

I. Below is hierarchy of model elements and the sequencing by which the models will be coordinated.

1. Structural and Architectural model
2. Miscellaneous steel
3. Perform preliminary space allocation
4. Identify hard constraints (locations of access panels, lights, A/V space requirements, etc.)
5. Main and medium pressure ducts from the shaft out
6. Main graded plumbing lines and vents
7. Sprinkler mains and branches
8. Cold and hot water mains and branches
9. Lighting fixtures and plumbing fixtures
10. Smaller sized ducts and flex ducts
11. Smaller size cold water and hot water piping, flex ducts, etc.

J. The Contractor shall not install any item until the coordination has been completed and reviewed by the Construction Manager, Owner, and A/E team.

K. The Contractor shall be responsible for coordination of all items that will affect the installation of the Work. This coordination shall include, but not be limited to voltage, ampacity, capacity, electrical and piping connections, space requirements, sequence of construction, building requirements and special conditions.

L. By submitting shop drawings on the project, the Contractor is indicating that all necessary coordination has been completed and that the systems, products, and equipment submitted can be installed in the building and will operate as specified and intended, in full coordination with all trades.

END OF SECTION 220201

SECTION 220300 - PLUMBING DEMOLITION FOR REMODELING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Demolition of plumbing systems and components.

B. The drawings do not show all demolition work required. The contractor shall make himself familiar with the required scope of work to accomplish the work required by these documents. All demolition work implied or required shall be included in the scope of this contract.

C. Outages of services as required by the new installation will be permitted but only at a time approved by the Owner. The contractor shall allow the Owner 2 weeks in order to schedule required outages. The time allowed for outages will not be during normal working hours unless otherwise approved by the Owner. All costs of outages, including overtime charges, shall be included in the contract amount.

1.2 RELATED SECTIONS

A. Alteration Project Procedures (may be present under Division 01).

B. Selective Demolition (may be present under Division 02).

1.3 WORK SEQUENCE, TIMING, COORDINATION WITH OWNER

A. The Owner will corporate with the Contractor, however, the following provisions must be observed:

1. During the construction of this project, normal facility activities will continue in existing buildings until new buildings or renovated areas are completed. Plumbing, fire protection, lighting, electrical, communications, heating, air conditioning, and ventilation systems will have to be maintained in service within the occupied spaces of the existing building.
2. A meeting will be held at the project site, prior to any construction, between the Owner's Representative, the General Contractor, the Sub-Contractors, and the Engineer to discuss Contractor's employee parking space, access, storage of equipment or materials, and use of the Owner's facilities or utilities. The Owner's decisions regarding such matters shall be final.

1.4 DEMOLITION AND WORK WITHIN EXISTING BUILDINGS

A. In the preparation of these documents every effort has been made to show the approximate locations of and connections to the existing piping, systems, equipment, and other apparatus related to this phase of the work. However, this Contractor shall be responsible for verifying all of the above information. This Contractor shall visit the existing site to inspect the facilities and

related areas. This Contractor shall inspect and verify all details and requirements of all the Contract Documents, prior to the submission of a proposal. All discrepancies between the Contract Documents and actual job-site conditions shall be resolved by his contractor, who shall produce drawings which shall be submitted to the Architect/Engineer for review. All labor and materials required to perform the work described shall be a part of this Contract.

B. All equipment and/or systems noted on the Drawings "To Remain" shall be inspected and tested on site to certify its working condition. A written report on the condition of all equipment to remain, including a copy of the test results and recommended remedial actions and costs shall be made by this Contractor to the Architect/Engineer for review.

C. All equipment and/or systems noted on the Drawings "To Be Removed" should be removed including associated pipe, fittings, and hangers and/or line supports. Where pipe is to be capped for future or end of line use, it shall be properly tagged with its function or service appropriately identified. Where existing equipment is to be removed or relocated and has an electric motor or connection, the Electrical Contractor shall disconnect motor or connection, remove wiring to a safe point and this Contractor shall remove or relocate motor or connection along with the equipment.

D. During the construction and remodeling, portions of the Project shall remain in service. Construction equipment, material tools, extension cords, etc., shall be arranged so as to present minimum hazard or interruption to the occupants of the building. None of the construction work shall interfere with the proper operation of the existing facility or be so conducted as to cause harm or danger to persons on the premises. All fire exits, stairs or corridors required for proper access, circulation or exit shall remain clear of equipment, materials, or debris. The General Contractor shall maintain barricades, other separations in corridors and other spaces where work is conducted.

E. Certain work during the demolition and construction phases of construction may require overtime or night shifts or temporary evacuation of the occupants. Coordinate and schedule all proposed down time with the Project Administrator at least seventy-two (72) hours in advance in writing.

F. Any salvageable equipment as determined by the Owner, shall be delivered to the Owner, and placed in storage at the location of his choice. All other debris shall be removed from the site immediately.

G. Equipment, piping, or other potential hazards to the occupants of the building shall not be left overnight outside of the designated working or construction area.

H. Make every effort to minimize damage to the existing building and the owner's property. Repair, patch, or replace as required any damage which might occur as a result of work at the site. Care shall be taken to minimize interference with the Owner's activities during construction and to keep construction disrupted areas to a minimum. Corporate with the Owner and other trades in scheduling and performance of the work.

I. Include in the contract price all rerouting of existing pipe, etc., and the reconnecting of the existing equipment and plumbing fixtures as necessitated by field conditions to allow the installation of the new systems regardless of whether or not such rerouting, reconnecting or relocating is shown on the drawings. Furnish all temporary pipe, duct, controls, etc., as required

to maintain heating, cooling, ventilation, and plumbing services for the existing areas with a minimum of interruption.

J. All existing plumbing fixtures, pipe, materials, equipment, and appurtenances not included in the remodel or alteration areas are to remain in place.

K. Pipe, duct, equipment and controls serving mechanical, plumbing and owner's equipment, etc., which is to remain but which is served by pipe, duct, equipment and controls that are disturbed by the remodeling work, shall be reconnected in such a manner as to leave this equipment in proper operating condition.

L. No portion of the fire protection systems shall be turned off, modified, or changed in any way without the express knowledge and written permission of the Owner's representative in order to protect systems that shall remain in service.

M. It is the intention of this Section of the Specifications to outline minimum requirements to furnish the Owner with a turn-key and operating system in cooperation with other trades with a minimum of disruption or downtime.

N. Refer to Architectural "Demolition and/or Alteration" plans for actual location of walls, ceiling, etc., being removed and/or remodeled.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. Materials and equipment for patching and extending work: As specified in individual Sections.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Field verify measurements and piping arrangements are as shown on Drawings.

B. Verify that abandoned piping and equipment serve only abandoned facilities.

C. Demolition Drawings are based on casual field observation and existing record documents. Report discrepancies to Owner before disturbing existing installation.

D. Beginning of demolition means installer accepts existing conditions.

3.2 PREPARATION

A. Disconnect plumbing systems in walls, floors, and ceilings scheduled for removal.

B. Coordinate utility service outages with Utility Company.

C. Provide temporary connections to maintain existing systems in service during construction. When work must be performed on energized equipment, use personnel experienced in such operations.

D. Existing Service: 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 24 hours before partially or completely disabling system. Minimize outage duration. Make temporary connections to maintain service in areas adjacent to work area.

E. Existing Fire Alarm System: Maintain existing system in service until new system is accepted. Disable system only to make switchovers and connections. Notify Owner and local fire service at least 24 hours before partially or completely disabling system. Minimize outage duration. Make temporary connections to maintain service in areas adjacent to work area.

3.3 DEMOLITION AND EXTENSION OF EXISTING PLUMBING WORK

A. Demolish and extend existing plumbing work under related provisions of Division 1, Division 2, and this Section.

B. Remove, relocate, and extend existing installations to accommodate new construction.

C. Remove abandoned piping to source of supply.

D. Remove exposed abandoned piping systems, including abandoned systems above accessible ceiling finishes. Cut systems flush with walls and floors, and patch surfaces.

E. Repair adjacent construction and finishes damaged during demolition and extension work.

F. Maintain access to existing installations which remain active. Modify installation or provide access panels as appropriate.

G. Extend existing installations using materials and methods compatible with existing installations, or as specified.

3.4 CLEANING AND REPAIR

A. Clean and repair existing materials and equipment which remain or are to be reused.

3.5 INSTALLATION

A. Install relocated materials and equipment under the provisions of Alteration Project Procedures Section.

3.6 REMOVAL OF MATERIALS

A. The contractor shall modify, remove, and/or relocate all materials and items 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. Materials and/or items scheduled for relocation, and which are damaged during dismantling or reassembly operations shall be repaired and restored to good operative condition. The contractor may, at his discretion and upon the approval of the Owner, substitute new materials and/or items of like design and quality in lieu of materials and/or items to be relocated.

B. All items which are to be relocated shall be carefully removed in reverse to original assembly or placement and protected until relocated. The contractor shall clean and repair and provide all new materials, fittings, and appurtenances required to complete the relocations and to restore to good operative order. All relocations shall be performed by workmen skilled in the work and in accordance with standard practice of the trades involved.

C. When items scheduled for relocation are found to be in damaged condition before work has been started on dismantling, the contractor shall call the attention of the Owner to such items and receive further instructions before removal. Items damaged in repositioning operations are the contractor's responsibility and shall be repaired or replaced by the contractor as approved by the Owner, at no additional cost to the Owner.

D. Service lines and wiring to items to be removed, salvaged, or relocated shall be removed to points indicated on the drawings, specified, or acceptable to the Owner. Service lines and wiring not scheduled for reuse shall be removed to the points at which reuse is to be continued or service is to remain. Such services shall be sealed, capped, or otherwise tied-off or disconnected in a safe manner acceptable to the Owner. All disconnections or connections into the existing facilities shall be done in such a manner as to result in minimum interruption of services to adjacent occupied areas. Services to existing areas or facilities which must remain in operation during the construction period shall not be interrupted without prior specific approval of the Owner as hereinbefore specified.

E. Certain work during the demolition phase of construction may require overtime or nighttime shifts or temporary evacuation of the occupants. Coordinate and schedule all proposed down time with the Owner's Representative at least 72 hours in advance.

F. Make every effort to minimize damage to the existing building and the Owner's property. Repair, patch, or replace as required any damage which might occur as a result of work at the site. Care shall be taken to minimize interference with the Owner's activities during construction. Cooperate with the Owner and other trades in scheduling and performance of the work.

G. Include in the contract price all rerouting of existing conduits, wiring, outlet boxes, fixtures, etc., and the reconnecting of existing fixtures as necessitated by field conditions to allow the installation of the new systems. Furnish all temporary conduit, wiring, boxes, etc., as required to maintain lighting and power service for the existing areas with a minimum of interruption. Remove wire and conduit back to nearest accessible active junction box and extend to existing homeruns as required.

H. The contractor shall be responsible for loss or damage to the existing facilities caused by him and his workmen and shall be responsible for repairing such loss or damage. The contractor shall send proper notices, make necessary arrangements, and perform other services required for the care, protection, and in-service maintenance of all electrical services for the new and

existing facilities. The contractor shall erect temporary barricades, with necessary safety devices, as required to protect personnel from injury, removing all such temporary protection upon completion of the work.

I. Where existing construction is removed to provide working and extension access to existing utilities, contractor shall remove doors, piping, conduit, outlet boxes, wiring, light fixtures, air conditioning ductwork and equipment, etc., to provide this access and shall reinstall same upon completion of work in the areas affected.

J. Where partitions, walls, floors, or ceilings of existing construction are being removed, all contractors shall remove and reinstall in locations approved by the Architect all devices required for the operation of the various systems installed in the existing construction.

END OF SECTION 220300

SECTION 220513 - COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

B. The Basic Materials and Methods, Section 220200, are included as a part of this Section as though written in full in this document.

1.2 SCOPE

A. Scope of the Work shall include the furnishing and complete installation of the equipment covered by this Section, with all auxiliaries, ready for owner's use. Provide electric motors, control panels, control and safety devices, and control wiring when specified or as required for proper operation of electrical systems associated with plumbing equipment and appurtenances.

B. WORK SPECIFIED ELSEWHERE:

1. Painting.
2. Power control wiring to motors and equipment.

1.3 WARRANTY

A. Warrant the Work specified herein for one year and motors for five years beginning on the date of substantial completion against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials and workmanship.

1.4 SUBMITTALS

A. SHOP DRAWINGS: Indicate size material, and finish. Show locations and installation procedures. Include details of joints, attachments, and clearances.

B. PRODUCT DATA: Submit schedules, charts, literature, and illustrations to indicate the performance, fabrication procedures variations, and accessories.

C. MOTOR NAMEPLATE INFORMATION: Manufacturer's name, address, utility, and operating data.

D. Refer to Division One for additional information.

1.5 DELIVERY AND STORAGE

A. DELIVERY: Deliver clearly labeled, undamaged materials in the manufacturers' unopened containers.

B. TIME 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.

PART 2 - PRODUCTS

2.1 ELECTRIC MOTORS

A. APPROVED MANUFACTURERS: Provide motors by a single manufacturer as much as possible.

1. Baldor
2. Marathon
3. Leeson-Lincoln Electric
4. General Electric
5. Westinghouse

B. TEMPERATURE RATING: Provide insulation as follows:

1. CLASS B: 40 degrees C maximum.
2. CLASS F:

a. Between 40 degrees C and 65 degrees C maximum.
b. Totally enclosed motors.

C. STARTING CAPABILITY: As required for service indicated five starts minimum per hour.

D. PHASES AND CURRENT: Verify electrical service compatibility with motors to be used.

1. UP TO 3/4 HP: Provide electronically commutated brushless DC single phase motors with built-in inverter and microprocessor-based control.
2. 1 HP AND LARGER: Provide squirrel-cage AC induction polyphase motors.
3. Name plate voltage shall be the same as the circuit's normal voltage, serving the motor.

E. SERVICE FACTOR: 1.15 for polyphase; 1.35 for single phase.

F. FRAMES: U-frames 1.5 hp. and larger.

G. BEARINGS: Provide sealed re-greasable ball bearings; with top mounted zerc lubrication fittings and bottom side drains minimum average life 100,000 hours typically, and others as follows:

1. Design for thrust where applicable.

2. PERMANENTLY SEALED: Where not accessible for greasing.
3. SLEEVE-TYPE WITH OIL CUPS: Light duty fractional horsepower motors or polyphase requiring minimum noise level.

H. ENCLOSURE TYPE: Provide enclosures per applications as follows:

1. CONCEALED INDOOR: Open drip-proof (ODP).
2. EXPOSED INDOOR: Splash-proof.
3. OUTDOOR TYPICAL: Type III, totally enclosed fan-cooled (TEFC).
4. OUTDOOR WEATHER PROTECTED: Weather protected II (WPII).
5. HAZARDOUS LOCATIONS: Explosion-proof.

I. OVERLOAD PROTECTION: Built-in sensing device for stopping motor in all phase legs and signaling where indicated for fractional horse power motors.

J. NOISE RATING: "Quiet" except where otherwise indicated.

K. EFFICIENCY: Minimum full load efficiency listed in the following table, when tested in accordance with IEEE Test Procedure 112A, Method B, including stray load loss measure.

NEMA Efficiency - 1800 RPM Synchronous Speed		
Motor Horsepower	Index Letter	Minimum Efficiency %
3 - 5	G	89.5
7.5	G	91.0
10	F	91.7
15 - 20	E	93.0
25 - 30	E	93.6
40	D	94.1
50	C	94.5
60	C	95.0
75	C	95.0
100 - 125	B	95.4
150 - 200	B	95.8
Hidden Paragraph NEMA Efficiency - 1200 RPM Synchronous Speed		
Motor Horsepower	Index Letter	Minimum Efficiency %
3 - 5	G	89.5
7.5	G	90.2
10	F	91.7
15	F	91.7
20	E	92.4
25 - 30	E	93.6
40 - 50	D	94.1
60	D	94.5
75	C	94.5
100 - 125	C	95.0
150 - 200	B	95.4

2.2 MOTOR CONTROLLERS (STARTERS)

A. All motor controllers (for equipment furnished under Division 22) shall be furnished under Division 22 and installed under Division 26 unless otherwise noted on the plans.

1. Starters shall be provided for 3 phase motors 1 horsepower and greater.

B. Motor starters shall be furnished as follows.

1. GENERAL: Motor starters shall be Square D Company Class 8536 across-the-line magnetic type, full-voltage, non-reversing (FAVOR) starter. All starters shall be constructed and tested in accordance with the latest NEMA standards, sizes and horsepower. ICE sizes are not acceptable. Starters shall be mounted in a general purpose dead front, painted steel enclosure and surface-mounted. Provide size and number of poles as shown and required by equipment served. Provide two speed, two winding or two speed, single winding motor starter as required for two speed motors.
2. CONTACTS: Magnetic starter contacts shall be double break solid silver alloy. All contacts shall be replaceable without removing power wiring or removing starter from panel. The starter shall have straight-through wiring.
3. OPERATING COILS: Operating coils shall be 120 volts and shall be of molded construction. When the coil fails, the starter shall open and shall not lock in the closed position.
4. OVERLOAD RELAYS: Provide manual reset, trip-free Class 20 overload relays in each phase conductor in of all starters. Overload relays shall be melting alloy type with visual trip indication. All 3 phase and single phase starters shall have one overload relay in each underground conductor. Relay shall not be field adjustable from manual to automatic reset. Provide 6 overload relays for two speed motor starters.
5. PILOT LIGHTS: Provide a red running pilot light for all motor starters. Pilot lights shall be mounted in the starter enclosure cover. Pilot lights shall be operated from an interlock on the motor starter and shall not be wired across the operating coil.
6. CONTROLS: Provide starters with HAND-OFF-AUTOMATIC switches. Coordinate additional motor starter controls with the requirements of Division 22. Motor starter controls shall be mounted in the starter enclosure cover.
7. CONTROL POWER TRANSFORMER: Provide a single-phase 480 volt control power transformer with each starter for 120 volt control power. Connect the primary side to the line side of the motor starter. The primary side shall be protected by a fuse for each conductor. The secondary side shall have one leg fused and one leg grounded. Arrange transformer terminals so that wiring to terminals will not be located above the transformer.
8. AUXILIARY CONTACTS: Each starter shall have one normally open and one normally closed convertible auxiliary contact in addition to the number of contacts required for the "holding interlock", remote monitoring, and control wiring. In addition, it shall be possible to field-install three more additional auxiliary contacts without removing existing wiring or removing the starter from its enclosure.
9. UNIT WIRING: Unit shall be completely pre-wired to terminals to eliminate any interior field wiring except for line and load power wiring and HVAC control wiring.
10. ENCLOSURES: All motor starter enclosures shall be NEMA 1, general purpose enclosures or NEMA-3R if mounted exposed to high moisture conditions. Provide NEMA 4X when located by cooling towers, fountains, or similar locations.

11. POWER MONITOR: Provide a square "D" 8430 MPS phase failure and under-voltage relay, base and wiring required for starters serving all 3 phase motors. Set the under-voltage setting according to minimum voltage required for the motor to operate within its range.

C. APPROVED MANUFACTURERS: Controller numbers are based on first named manufacturer. Provide one of the following manufacturers.

1. Siemens.
2. Square D.
3. General Electric.
4. Eaton.

2.3 COMBINATION MOTOR STARTERS

A. GENERAL: Combination motor starters shall consist of a magnetic starter and a fusible or non-fusible disconnect switch in a dead front, painted steel NEMA 1 enclosure unless otherwise noted and shall be surface-mounted. Size and number of poles shall as shown and required by equipment served. Combination motor starters shall be as specified for motor starters in Paragraph 2.1/B, except as modified herein.

B. DISCONNECT SWITCH: Disconnect switches shall be as specified in Division 26.

C. APPROVED MANUFACTURERS: Controller numbers are based on first named manufacturer. Provide one of the following manufacturers.

1. Siemens.
2. Square D.
3. General Electric.

PART 3 - EXECUTION

3.1 INSTALLATION

A. All equipment shall be installed in accordance with the manufacturer's recommendations and printed installation instructions.

B. All items required for a complete and proper installation are not necessarily indicated on the plans or in the specifications. Contractors’ price shall include all items required as per manufacturer's requirements.

C. Install in a professional manner. Any part or parts not meeting this requirement shall be replaced or rebuilt without extra expense to Owner.

D. Install rotating equipment in static and dynamic balance.

E. Provide foundations, supports, and isolators properly adjusted to allow minimum vibration transmission within the building.

F. Correct objectionable noise or vibration transmission in order to operate equipment satisfactorily as determined by the Engineer.

END OF SECTION 220513

SECTION 220516 - EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

B. The Basic Materials and Methods, Section 220200, are included as a part of this Section as though written in full in this document.

1.2 SCOPE

A. The scope of the work shall include the furnishing and complete installation of the fittings and items covered by this Section, with all appurtenances, ready for the Owner’s use.

B. Include the following work in addition to items normally part of this Section:

1. Expansion joints and compensators.
2. Pipe loops, offsets, and swing joints.

1.3 RELATED WORK

A. Section 220200 - Basic Materials and Methods for Plumbing

B. Section 220529 - Hangers and Support for Plumbing Piping and Equipment

C. Section 221000 - Plumbing Piping

1.4 REFERENCES

A. IAPMO (UPC) - Uniform Plumbing Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

B. NSF 61 - Drinking Water System Components - Health Effects; 2023, with Errata.

1.5 PERFORMANCE REQUIREMENTS

A. Provide structural work and equipment required to control expansion and contraction of piping. Verify that anchors, guides, and expansion joints provided, adequately protect system.

B. Expansion Calculations:

1. Installation Temperature: 50 degrees F (10 degrees C).
2. Domestic Hot Water: 140 degrees F (60 degrees C).
3. Safety Factor: 30 percent.

C. Pipe sizes indicated are to establish a minimum quality of compensator. Refer to manufacturer’s literature for model series for different pipe sizes.

1.6 SUBMITTALS

A. Submit shop drawings under provisions of Division One.

B. Product Data:

1. Expansion Joints: Indicate maximum temperature and pressure rating, and maximum expansion compensation.
2. Pipe loops, offsets, and swing joints: Indicate temperature rise, developed lengths, pipe size, material expansion coefficient-allowable stress-modulus of elasticity, and final calculated amount of expansion. Indicate bend, loop, offset & return dimensions coinciding with the calculated expansion.

C. Design Data: Indicate selection calculations.

D. Manufacturer's Installation Instructions: Indicate special procedures, and external controls.

1.7 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Division One.

B. Record actual locations of expansion joints, fittings, anchors, and guides.

1.8 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Division One.

B. Maintenance Data: Include adjustment instructions.

1.9 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the products specified in this section with minimum five years documented experience.

B. Design expansion compensation system under direct supervision of a Professional Engineer experienced in design of this work and licensed in the state where the project is located.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, project, and handle products to site under provisions of Division One.

B. Accept expansion joints on site in factory packing with shipping bars and positioning devices intact. Inspect for damage.

C. Protect equipment from exposure by leaving factory coverings, pipe end protection, and packaging in place until installation.

1.11 WARRANTY

A. Provide five year warranty under provisions of Division One.

B. Warranty: Include coverage for leak free performance of packed expansion joints.

1.12 EXTRA MATERIALS

A. Furnish under provisions of Division One.

PART 2 - PRODUCTS

2.1 EXPANSION JOINTS

A. Bellows Type (Based on 4" Pipe):

1. Manufacturers:

a. VMC Group, Style EB
b. Triplex, Model Resistoflex R6905
c. Mercer Rubber Company, Style 803 or 805 (Mason Industries)
d. Metraflex

2. Body: Monel wire reinforced molded TFE teflon bellows, multiple arch.
3. Pressure Rating: 70 psig WSP and 250 degrees F (66 degrees C).
4. Maximum Compression: 1 inch.
5. Maximum Extension: 1 inch.
6. Maximum Offset: 1/2 inch.
7. Joint: ASA standard ductile iron flanges, integral molded gasket.
8. Size: Use pipe sized units.
9. Accessories: Control rod limit bolts.
10. Application: Steel piping 8 inch and under.

B. Pre-manufactured Loop Type:

1. Manufacturers:

a. Flexicraft Industries
b. Metraflex MLS-UPC-80 series

2. Materials of construction: Copper custom 180 degrees bend (or 90 degree elbows with spool), copper 90 degree elbows for connections to piping, bronze hose and braid.
3. Certifications: NSF 61 lead-free compliant, IAPMO (UPC) approved.
4. Working Pressure: No less than 200 psi at 250 degrees F.
5. Allowable Movement: +/- 4 inches.
6. Labeled from the manufacturer and provided complete with attached support bracket and drain plug.
7. Size: Same as piping being served.
8. Installation: In strict accordance with manufacturer's recommendations, including support.
9. Application: Copper piping 4 inch and under.

2.2 ACCESSORIES

A. Pipe Alignment Guides to Direct Axial Movement:

1. Manufacturers:

a. Triplex, Model Flexonics
b. Metraflex

2. Welded steel construction bolt together two-piece design, frame with four mounting holes, shop painted, spider type guide, exact style/model as necessary for bare or insulated pipe to match size and thickness as appropriate, 4 inch movement standard.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide miscellaneous metals to rigidly anchor pipe to building structure. Provide pipe guides so that movement takes place along axis of pipe only. Erect piping such that strain and weight is not on cast connections or apparatus.

C. Provide support and equipment required to control expansion and contraction of piping. Provide loops, pipe offsets, swing joints, or expansion joints where required. This shall include where piping crosses expansion joints in the building.

3.2 MANUFACTURER'S FIELD SERVICES

A. Prepare and start systems under provisions of Division One.

B. Provide inspection services by manufacturer's representative for final installing and to certify the installation is in accordance with manufacturer's recommendations and expansion joints and accessories are performing satisfactorily.

END OF SECTION 220516

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SECTION 220529 - HANGERS AND SUPPORT FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

B. The Basic Materials and Methods, Section 220200, are included as a part of this Section as though written in full in this document.

1.2 WORK INCLUDED

A. Pipe, and equipment hangers, supports, and associated anchors.

B. Sleeves and seals.

C. Flashing and sealing equipment and pipe stacks.

1.3 RELATED WORK

A. Section 220200 - Basic Materials and Methods for Plumbing

B. Section 220719 - Plumbing Piping Insulation

C. Section 221000 - Plumbing Piping

D. Section 221121 - Natural Gas Piping Systems

1.4 REFERENCES

A. ASME B31.1 - Power Piping; 2024.

B. ASME B31.9 - Building Services Piping; 2020.

C. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2018, with Amendment (2019).

1.5 QUALITY ASSURANCE

A. Hangers and Supports for Plumbing Piping: In conformance with ASME B31.1 and ASME B31.9.

B. Hangers and Supports for Plumbing Piping: In conformance with MSS SP-58.

1.6 SUBMITTALS

A. Submit shop drawings and product data under provisions of Division One.

B. Indicate hanger and support framing and attachment methods.

PART 2 - PRODUCTS

2.1 PIPE HANGERS AND SUPPORTS

A. Hangers for Pipe Sizes 1/2 to 1-1/2 Inch Malleable iron, adjustable swivel, split ring.

B. Hangers for Pipe Sizes 2 to 4 Inches Carbon steel, adjustable, clevis.

C. Hangers for Pipe Sizes 6 Inches and Over: Adjustable steel yoke, cast iron roll, double hanger.

D. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods; cast iron roll and stand for pipe sizes 6 inches and over.

E. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.

F. Wall Support for Pipe Sizes 4 Inches and Over: adjustable steel yoke and cast-iron roller.

G. Vertical Support: Steel riser clamp.

H. Floor Support for Pipe Sizes to 4 Inches: Cast iron adjustable pipe saddle, locknut nipple, floor flange, and concrete pier or steel support.

I. Floor Support for Pipe Sizes 6 Inches and Over: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.

J. Roof Pipe Supports and Hangers: Free-standing manufactured pipe support system with hot dip galvanized steel components and hardware with UV-inhibited injection molded high density/high impact black polypropylene base material. Portable Pipe Hangers, Inc. or approved equal.

For pipes 2-1/2” and smaller	Type PP10-R, with pipe roller support
For pipes 3” through 8”	Type PS-1-2, with pipe roller support
For multiple pipes	Type PSE - Custom

K. Copper Pipe Hangers: Copper coated steel clevis type hanger complete with PVC coating. Eaton B-Line series B-3104-CTC or pre-approved equal.

L. For installation of protective shields also reference Section 220719.

M. Shields for Vertical Copper Pipe Risers: Sheet lead.

N. Pipe Rough-In Supports in Walls/Chases: Provide pre-formed plastic pipe supports, Sioux Chief "Pipe Titan," Hold Rite or equal.

2.2 HANGER RODS

A. Galvanized Hanger Rods: Threaded both ends, threaded one end, or continuous threaded.

2.3 INSERTS

A. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

2.4 FLASHING

A. Metal Flashing: 20 gage galvanized steel.

B. Lead Flashing: 4 lb./sq. ft. sheet lead for waterproofing.

C. Caps: Steel, 20 gauge minimum; 16 gage at fire resistant elements.

D. Coordinate with roofing contractor/architect for type of flashing on metal roofs.

2.5 EQUIPMENT CURBS

A. Fabricate curbs of hot dipped galvanized steel.

2.6 ROOFTOP PIPE SUPPORTS

A. All roof-mounted piping shall be supported with engineered prefabricated piping support systems specifically designed to be installed on the roof without roof penetrations, flashing, or damage to the roofing material.

1. Bases shall be made of UV protected HDPE.
2. Frames shall be made of hot dipped galvanized structural steel.
3. Nuts, threads, and washers shall be hot dipped galvanized steel.
4. System shall be specifically designed to fit the piping and the actual conditions of service.
5. Wood supports are not acceptable.
6. Portable Pipe Hanger (PHP) system or pre-approved equal, installed per manufacturer's instructions.

2.7 SLEEVES

A. All pipe penetrations through walls, floors, floor-ceiling assemblies, etc. shall be sleeved to ensure no direct contact between the pipe and that which it passes through. All installations shall be provided consistent with the fire and smoke safeguards required by the building code per the fire-resistance rating as indicated on the architectural drawings and shall be provided consistent with the assemblies/methods indicated on the architectural drawings.

B. Unless required otherwise (the most stringent requirement shall govern), sleeves for pipes:

1. Through nonfire-resistance-rated floors shall be formed with 18 gage galvanized steel, tack welded to form a uniform sleeve.
2. Through nonfire-resistance-rated walls, through grade beams and foundation walls, and through potentially wet floors shall be formed with schedule 40 steel pipe, galvanized.
3. Through assemblies including but not limited to fire-resistance-rated walls-barriers-partitions, smoke barriers-partitions, etc. shall be schedule 40 steel pipe securely fastened to the rated assembly. All annular spaces shall be firestopped with an approved penetration firestop system (UL listed) compatible with the pipe material and installed per the manufacturer's recommendations.

C. Fire Stopping Insulation: Glass fiber type, non-combustible, UL listed.

D. Caulk: Paintable 25-year acrylic sealant.

E. Pipe Alignment Guides: Factory fabricated, of cast semi-steel or heavy fabricated steel, consisting of bolted, two-section outer cylinder and base with two-section guiding spider that bolts tightly to pipe. Length of guides shall be as recommended by manufacturer to allow indicated travel.

2.8 FABRICATION

A. Size sleeves are large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.

B. Design hangers without disengagement of supported pipe.

C. Design roof supports without roof penetrations, flashing or damage to the roofing material.

2.9 FINISH

A. Exposed steel hangers, supports, and appurtenances shall be hot-dipped galvanized. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

PART 3 - EXECUTION

3.1 INSERTS

A. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams. Coordinate with structural engineer for placement of inserts.

B. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.

C. Where concrete slabs form finished ceiling, provide inserts to be flush with slab surface.

D. Where inserts are omitted, drill through concrete slab from below and provide thru-bolt with recessed square steel plate and nut recessed into and grouted flush with slab. Verify with structural engineer prior to start of work.

3.2 PIPE HANGERS AND SUPPORTS

A. Support horizontal piping as follows:

PIPE SIZE	MAX/ HANGER SPACING	HANGER DIAMETER
(Steel Pipe)		
1/2 to 1-1/4 inch	7'-0"	3/8"
1-1/2 to 3 inch	10'-0"	3/8"
4 to 6 inch	10'-0"	1/2"
8 to 10 inch	10'-0"	5/8"
12 to 14 inch	10'-0"	3/4"
15 inch and over	10'-0"	7/8"
(Copper Pipe)		
1/2 to 1-1/4 inch	5'-0"	3/8"
1-1/2 to 2-1/2 inch	8'-0"	3/8"
3 to 4 inch	10'-0"	3/8"
6 to 8 inch	10'-0"	1/2"
(Cast Iron Pipe)		
2 to 3 inch	5'-0"	3/8"
4 to 6 inch	10'-0"	1/2"
8 to 10 inch	10'-0"	5/8"
12 to 14 inch	10'-0"	3/4"
15 inch and over	10'-0"	7/8"
(PVC Pipe)		
1-1/2 to 4 inch	4'-0"	3/8"
6 to 8 inch	4'-0"	1/2"
10 inch and over	4'-0"	5/8"

B. Sagging of horizontal pipe is unacceptable.

C. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.

D. Place a hanger within 12 inches of each horizontal elbow and at the vertical horizontal transition.

E. Use hangers with 1-1/2 inch minimum vertical adjustment.

F. Support horizontal cast iron pipe adjacent to each hub, with 5 feet maximum spacing between hangers. Also reference specific requirements for cast iron piping installation in Section 221000, Part 3 Execution.

G. Support vertical piping at every floor. Support vertical cast iron pipe at each floor at hub.

H. For vertical shaft or chase applications where floor slab supported riser clamps cannot be provided to keep the pipe in alignment and to support the weight of the pipe and its contents, ensure to provide suitable fasteners and hardware, braces, unistrut, structural steel members, etc. to accommodate the pipe installation. Coordinate all such work with the project structural engineer to ensure that necessary members and attachment points are provided accordingly to bear the weight of the functioning piping.

I. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.

J. Support riser piping independently of connected horizontal piping.

K. Install hangers with nut at base and above hanger; tighten upper nut to hanger after final installation adjustments.

3.3 INSULATED PIPING

A. Clamps: Attach galvanized clamps, including spacers (if any), to piping with clamps projecting through insulation; do not exceed pipe stresses allowed by ASME B31.9.

B. Saddles: Install galvanized protection saddles MSS Type 39 where insulation without vapor barrier is indicated. Fill interior voids with segments of insulation that match adjoining pipe insulation. Secure the full contact area of the saddle to the pipe insulation with 1/8” thick coat of mastic and provide stainless steel banding on each side of the hanger.

C. Shields: Install protective shields MSS Type 40 on insulated piping that has vapor barrier. Secure the full contact area of the shield to the pipe insulation with 1/8” thick coat of mastic and provide stainless steel banding on each side of the hanger.

D. Galvanized sheet metal shields shall span an arc of 180 degrees and shall have dimensions not less than the following:

Nominal Pipe Size	Shield Length	Gauge Thickness
1/4 through 3-1/2 inch	12 inch	18
4 inch	12 inch	16
5 through 6 inch	18 inch	16
8 through 14 inch	24 inch	14
16 through 24 inch	24 inch	12

E. Ensure to provide an insert of high-density insulation (calcium silicate) at each hanger/support to prevent the weight of the pipe from otherwise crushing the insulation. This insert material shall be at least as long as the associated protective shield.

F. Thermal Hanger Shields: Install where indicated, with insulation of same thickness as piping.

3.4 EQUIPMENT BASES AND SUPPORTS

A. Provide equipment bases of concrete.

B. Provide templates, anchor bolts, and accessories for mounting and anchoring equipment.

C. Construct support of steel members. Brace and fasten with flanges bolted to structure.

D. Provide rigid anchors for pipes after vibration isolation components are installed.

3.5 FLASHING

A. Provide flexible flashing and metal counter flashing where piping penetrates weather or waterproofed walls, floors, and roofs.

B. Flash vent and soil pipes projecting 8 inches minimum above finished roof surface with lead worked one inch minimum into hub, 8 inches minimum clear on sides with 24 x 24 inches sheet size. For pipes through outside walls, turn flanges back into wall and caulk, metal counter flash and seal.

C. Flash floor drains in floors with topping over finished areas with lead, 10 inches clear on sides with minimum 36 x 36 inch sheet size. Fasten flashing to drain clamp device.

D. Seal floor shower mop sink and all other drains watertight to adjacent materials.

E. Provide curbs for mechanical roof installations 8 inches minimum high above roofing surface. Contact architect for all flashing details and roof construction. Seal penetrations watertight.

3.6 SLEEVES

A. Set sleeves in position in formwork. Provide reinforcing around sleeves.

B. Extend sleeves through floors minimum one inch above finished floor level. Caulk sleeves full depth with fire rated thermafiber and 3M caulking and provide floor plate.

C. Where piping penetrates floor, ceiling, or wall, close off space between pipe and adjacent work with UL listed fire stopping insulation and caulk seal air tight. Provide close fitting metal collar or escutcheon covers at both sides of penetration.

END OF SECTION 220529

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SECTION 220548 - VIBRATION AND SEISMIC CONTROLS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

B. The Basic Materials and Methods, Section 220200, are included as a part of this Section as though written in full in this document.

1.1 SCOPE

C. The scope of the work shall include the furnishing and complete installation of vibration & sound control products and seismic controls covered by this Section, with all appurtenances, ready for the Owner's use.

D. Include the following work in addition to items normally part of this Section:

1. Vibration and shock mounting.
2. Flexible pipe connectors.
3. Seismic restraints.

1.2 RELATED WORK

E. Section 220529 - Hangers and Support for Plumbing Piping and Equipment

F. Section 221000 - Plumbing Piping

G. Section 223000 - Plumbing Equipment

1.3 REFERENCES

H. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

I. NFPA 99 - Health Care Facilities Code; 2024, with Errata.

J. NSF 61 - Drinking Water System Components - Health Effects; 2023, with Errata.

1.4 QUALITY ASSURANCE

K. Manufacturer's Qualifications: Firms regularly engaged in manufacture of vibration control and seismic products, of type, size, and capacity required, whose products have been in satisfactory use in similar service for not less than 5 years.

L. Vibration and sound control products shall conform to ASHRAE criteria for average noise criteria (NC) curves for all equipment at full load conditions.

M. Unless indicated otherwise, sound and vibration control products and seismic products shall be provided by a single manufacturer.

1.5 SUBMITTALS

N. SHOP DRAWINGS: Indicate size, material, and finish. Show locations and installation procedures. Include details of joints, attachments, and clearances.

O. PRODUCT DATA: Submit schedules, charts, literature, and illustrations to indicate the performance, fabrication procedures, product variations, and accessories.

PART 2 - PRODUCTS

1.6 ACCEPTABLE MANUFACTURERS

A. VMC Group

B. Mason Industries, Inc.

C. Kinetics Noise Control, Inc.

D. Vibration Eliminator Co., Inc.

E. Unisource Manufacturing (as specifically noted below)

1.7 GENERAL

F. Provide vibration isolation supports for equipment, piping, and appurtenances to prevent transmission of vibration and noise to the building structure that may cause discomfort to the occupants.

G. Provide seismic restraints, supports, and attachments suitable for the applicable seismic loads in seismic design category areas as required by the ICC (IBC) and local code requirements.

H. Where Basis of Design manufacturer and model numbers are indicated, the products of the other listed manufacturers above will be acceptable provided they comply with all of the requirements of this specification.

1.8 BASE MOUNTED PUMPS

I. Provide VMC Group model SP-NR, style E, elastomeric isolation pads consisting of two layers of 3/8'' thick alternate ribbed elastomeric pad bonded to a 16 gauge galvanized steel separator plate.

J. Pads shall be sized for approximately 40 psi loading and 1/8'' deflection.

K. Provide inertia bases for all base mounted pump applications in which the pumps are to be installed on any floor level other than the ground floor or grade level. Inertia bases shall also be provided for base mounted pump applications in which the associated room where they are housed is in a noise sensitive location, regardless of floor level.

1.9 FLOOR MOUNTED AIR COMPRESSORS, VACUUM PUMPS, AND SIMILAR EQUIPMENT

L. Provide VMC Group model CAL-2 aluminum housed isolators sized for 2" static deflection. Cast iron or steel housings may be used provided they are hot-dip galvanized after fabrication.

M. If floor mounted equipment is furnished with an internal vibration isolation option, provide VMC Group model SP-NRC, style E, consisting of two layers of 1" thick ribbed elastomeric pad bonded to a 16-gauge galvanized steel separator plate to address high frequency breakout and afford additional unit elevation for required drains. Ribbed elastomeric pads shall be located in accordance with the equipment manufacturer's recommendations.

1.10 PIPING

N. Provide line size stainless steel flexible connectors at connections to air compressors, domestic boosters, and other pumps (excluding submersible pumps and small circulators).

1. Type 321 SS annular corrugated interior hose.
2. Type 304 SS single braid exterior hose.
3. End connection type(s) as suited for the application and the equipment and piping being served, but in no case welded or soldered ends.
4. Ensure NSF 61 compliance for all potable water applications.
5. When applied with dissimilar pipe materials, dielectric connections must be provided at both ends.

O. For medical gas applications (or similar), flexible connectors at intake and outlet of medical air compressors and vacuum pumps shall be specifically produced for such use:

1. They shall be documented, purged, and brazed to NFPA 99 standards.
2. They shall be cleaned, capped, and bagged in accordance with CGA (Compressed Gas Association) G-4.1.
3. Bronze hose and braid, copper return elbow, and copper sweat end connections. Sizes 2-1/2" through 4" shall utilize stainless steel hose and braid, stainless steel return elbow, and copper sweat end fittings silver brazed to the assembly.

4. Unisource Manufacturing Series 455 "MedFlex"

1.11 CORROSION PROTECTION

P. All vibration isolators shall be designed and treated for resistance to corrosion.

Q. Steel components: PVC coated or phosphated and painted with industrial grade enamel. Nuts, bolts, and washers: zinc electroplated.

PART 3 - EXECUTION

1.12 INSTALLATION

A. All equipment shall be installed in accordance with the manufacturer's recommendations and printed installation instructions.

B. All items required for a complete and proper installation are not necessarily indicated on the plans or in the specifications. Provide all items required as per manufacturer's requirements.

C. The vibration isolation supplier shall certify in writing that he has inspected the installation and that all external isolation materials and devices are installed correctly and functioning properly.

END OF SECTION 220548

SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

B. The Basic Materials and Methods, Section 220200, are included as a part of this Section as though written in full in this document.

1.2 SCOPE

A. The scope of the work shall include the furnishing and complete installation of the items covered by this Section, with all appurtenances, ready for owner's use.

B. All plumbing piping shall be appropriately labeled.

C. Refer to Architectural Sections for any additional requirements.

1.3 RELATED WORK

A. Section 221000 - Plumbing Piping

B. Section 220719 - Plumbing Piping Insulation

1.4 REFERENCES

A. ASME A13.1 - Scheme for the Identification of Piping Systems; 2023.

PART 2 - PRODUCTS

2.1 VALVE AND PIPE IDENTIFICATION

A. Valves:

1. All valves shall be identified with a 1-1/2" diameter brass valve tag with stamped, black or red filled characters. Service designations shall be 1/4" letters and valve numbers shall be 1/2" numbers. Secure tags to valve handles by use of copper or Monel wire seals. For any services not identified below, contact Engineer in advance for approval. Service designations:

a. Domestic cold water: DCW
b. Domestic hot water: DHW
c. Domestic hot water return: DHWR
d. Natural gas: GAS
e. Compressed air: AIR

2. All valves on the project shall be numbered sequentially, with valves for any one system and/or trade grouped together.
3. Valve tags are not required if the valve is located within 3'-0" of the equipment being served and the service is obvious.
4. Catalog a complete written record of all valves on the project, whether tagged or not. Include manufacturer, model number, size, service, system pressure (if like services with differing pressures are present on the project), location, valve tag data, and a description of the equipment/room/area served. Any valves which must be operated in sequence shall be indicated as such. Prepare a valve chart/schedule with all such information and include this chart/schedule in the project Operating and Maintenance Manual.
5. Mark all valve locations on the record drawings with appropriate identifying symbols or information to align with the above referenced valve chart/schedule. In addition to the O&M submission, provide the Owner with a digital copy (PDF format) of all such information in high resolution, suitable for printing as full-size drawings.
6. Tags and fastenings shall be manufactured by the Seton Nameplate Corporation or approved equal.
7. In addition to tags, all isolation valves serving emergency safety fixtures shall be provided with immediately adjacent clear and permanent signage indicating their purpose so as to avoid accidental shut-off.

B. Pipe Marking:

1. All interior visible piping located in accessible spaces shall be provided with pipe markers. Accessible spaces shall include, but not necessarily be limited to, the following: above accessible ceilings, inside equipment rooms and utility spaces, in attic spaces, in crawl spaces, and in chase spaces, etc. viewable via access panels.
2. All exterior visible piping shall be provided with pipe markers.
3. Peel-off, self-adhesive, sticker type labels shall not be acceptable.
4. Pipe markers shall be manufactured with rigid vinyl PVC, printed with UV resistant ink, abrasion, and chemical resistant, suited for indoor or outdoor use and for a service temperature of -40 degrees F to 160 degrees F.

    a. For pipes up to 6” provide cylindrically pre-coiled markers that snap into place without the need for tape or adhesives.
    b. For pipes 6” and larger provide flat snap-around markers installed using manufacturer’s heavy-duty nylon ties or stainless-steel strapping.
    c. Markers shall indicate the pipe service, include flow directional arrows, and meet ASME A13.1.

5. Acceptable manufacturers:

    a. Seton Setmark Pipe Markers
    b. Brimar Industries Pipemarker System 1 Pipe Markers
    c. Brady Corporation

6. Markers shall be provided after final insulating, painting, jacketing, etc. of piping and per manufacturer's installation instructions. Strapping (applies to large diameter markers only) shall be snug but shall not compromise any insulation. All such strapping shall also be cleanly trimmed of excess material.
7. Markers shall be provided in accordance with ASME A13.1 requirements. Specific items indicated below are not intended as a substitute for this complete standard. Markers shall be provided:

    a. On both sides of each floor or wall penetration.
    b. On each side of each tee.
    c. On each side of each valve and/or valve group.
    d. On each side of each piece of equipment.
    e. On straight pipe runs at equally spaced intervals not to exceed 50 feet.
    f. In congested areas, on each pipe at the point it enters and exits the area.
    g. At the point of connection to each piece of equipment and automatic control valve.
    h. Where they are readily visible to personnel from the point of normal approach.
    i. With letter height and length of color field according to the size of the pipe served.
    j. For non-potable water not less than once per room and at equally spaced intervals not to exceed 20 feet.

8. Color scheme of markers shall be as indicated below and otherwise in accordance with ANSI/ASME color recommendations. Legend color indicates color of legend text and flow directional arrow:

SYSTEM	LABEL COLOR	LEGEND	LEGEND COLOR
Sanitary Sewer	Green	Sanitary Sewer	White
	Green	Plumbing Vent	White
Storm Drain	Green	Storm Drain	White
	Green	Overflow	White
Domestic Water	Green	Domestic Cold Water	White
Domestic Hot Water	Green	Domestic Hot Water	White
Domestic Hot Water Return	Green	Domestic Hot Water Return	White
Fire Protection	Red	Fire Protection	White
	Red	Fire Sprinkler	White
Fuel Gas	Yellow	Natural Gas	Black
	Yellow	Propane Gas	Black
Diesel	Yellow	Diesel Oil	Black
Compressed Air	Blue	Compressed Air	White
Nitrogen	Orange	Nitrogen	Black
Carbon Dioxide	Orange	Carbon Dioxide	Black
Non-Potable Water	Yellow	Caution: Non-Potable Water, Do Not Drink	Black
Deionized Water	Green	Deionized Water	White
Reverse Osmosis Water	Green	R.O. Water	White
Acid Waste	Orange	Acid Waste	Black
		Acid Vent	Black

C. Pipe Painting:

1. Pipe painting shall be per the color schedule below or as directed by the Architect. Confirm all color selections with Architect prior to installation, in particular for exposed piping in publicly occupiable areas.
2. All exterior piping shall be painted.
3. All piping subject to corrosive conditions shall be painted. This shall include, but not necessarily be limited to: natatoriums, pool equipment rooms, chemical and metal processing areas, and animal pens.
4. All exposed piping shall be painted (including, but not limited to piping in mechanical rooms, kitchens, and storage rooms).
5. Paint color schedule:

System	Color
Storm Sewer	White
Sanitary Sewer Waste and Vent	Light Gray
Domestic Cold Water	Dark Blue
Domestic Hot Water Supply and Return	Orange
Fuel Gas (except for utility provider installed piping)	Yellow, unless specifically indicated/required otherwise by Architect or AHJ

2.2 EQUIPMENT IDENTIFICATION

A. Plumbing equipment shall be identified by means of nameplates permanently attached to the equipment. Nameplates shall be engraved laminated plastic or etched metal. Submittals shall include dimensions and lettering format for approval. Attachment shall be with escutcheon pins, self-tapping screws, or machine screws.

PART 3 - EXECUTION

3.1 INSTALLATION REQUIREMENTS

A. All labeling equipment shall be installed per manufacturer’s printed installation instructions.

B. All items required for a complete and proper installation are not necessarily indicated on the plans or in the specifications. Contractor’s price shall include all items as required per manufacturers' requirements.

C. All piping to be painted shall be cleaned of rust, dirt, grease, oil, and all other contaminants prior to painting. Provide primer if and as recommended by the paint manufacturer. Provide a quality polyamine epoxy paint over all surfaces of pipe.

END OF SECTION 220553

SECTION 220716 - PLUMBING EQUIPMENT INSULATION

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

B. The Basic Materials and Methods, Section 220200, are included as a part of this Section as though written in full in this document.

1.2 SCOPE

A. Scope of the Work shall include the furnishing and complete installation of the equipment covered by this Section, with all auxiliaries, ready for owner's use.

B. Work specified elsewhere.

1. Basic materials and methods.
2. Piping systems.

1.3 REFERENCES

A. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

C. ICC (IECC) - International Energy Conservation Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

D. SCAQMD 1168 - Adhesive and Sealant Applications; 1989, with Amendment (2022).

E. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.4 WARRANTY

A. Warrant the Work specified herein for one year against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials and workmanship.

B. Defects shall include, but not be limited to, the following:

1. Mildewing.
2. Peeling, cracking, and blistering.
3. Condensation on exterior surfaces.

1.5 SUBMITTALS

A. SHOP DRAWINGS: Indicate size, material, and finish. Show locations and installation procedures. Include details of joints, attachments, and clearances.

B. PRODUCT DATA: Submit schedules, charts, literature, and illustrations to indicate the performance, fabrication procedures, product variations, and accessories.

1.6 DELIVERY AND STORAGE

A. DELIVERY: Deliver undamaged materials in the manufacturer's unopened containers clearly labeled with flame and smoke ratings.

PART 2 - PRODUCTS

2.1 EQUIPMENT INSULATION

A. It is the intent of these specifications to secure superior quality workmanship resulting in an absolutely satisfactory installation of insulation from the standpoint of both function and appearance. Particular attention shall be given to valves, fittings, pumps, etc., requiring low temperature insulation to ensure full thickness of insulation and proper application of the vapor seal. All flaps of vapor barrier jackets and/or canvas covering must be neatly and securely smoothed and sealed down.

B. The type of insulation and its installation shall be in strict accordance with these specifications for each service, and the application technique shall be as recommended by the manufacturer. All insulation types, together with adhesives and finishes shall be submitted and approved before any insulation is installed.

C. A sample quantity of each type insulation and each type application shall be installed and approval secured prior to proceeding with the main body of the work. Condensation caused by improper installation of insulation shall be corrected by Installing Contractor. Any damage caused by condensation shall be made good at no cost to the Owner or Architect/Engineer.

D. Glass mineral wool materials as manufactured by Knauf Insulation, Owens/Corning, Certain-Teed or Johns Manville will be acceptable, if they comply with the specifications.

E. All insulation shall be listed and labeled to have a composite (insulation, jacket or facing, and adhesive used to adhere the facing or jacket to insulation) flame spread index of not more than

25 and smoke-developed index of not more than 50 when tested in accordance with ASTM E84 and UL 723.

F. All insulation shall comply with minimum requirements of International Energy Conservation Code ICC (IECC) and ASHRAE Std 90.1 I-P.

G. Accessories, such as adhesives, mastics and cements shall have the same component ratings as listed above. Additionally, all adhesives and sealants used on the interior of the building (i.e., inside of the weatherproofing system and applied on-site) shall be comprised of low-emitting materials that comply with VOC limits prescribed by SCAQMD 1168.

H. All products or their shipping cartons shall have a label affixed, indicating flame and smoke ratings do not exceed the above requirements.

PART 3 - EXECUTION

3.1 INSTALLATION

A. All insulation shall be installed in accordance with the manufacturer's recommendations and printed installation instructions.

B. All items required for a complete and proper installation are not necessarily indicated on the plans or in the specifications. Provide all items required as per manufacturers requirements.

END OF SECTION 220716

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SECTION 220719 - PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

B. The Basic Materials and Methods, Section 220200, are included as a part of this Section as though written in full in this document.

1.2 SCOPE

A. Scope of the Work shall include the furnishing and complete installation of the equipment covered by this Section, with all auxiliaries, ready for owner's use.

B. Furnish and install piping insulation to:

1. Interior domestic hot water and hot water return piping.
2. Interior domestic cold water piping.
3. Exterior domestic cold water piping.
4. Drain bodies and associated piping.
5. Condensate drainage piping.
6. All pipes subject to freezing conditions shall be insulated.

C. Work specified elsewhere.

1. Painting.
2. Pipe hangers and supports.

D. For insulation purposes, piping is defined as the complete piping system including supplies and returns, pipes, valves, automatic control valve bodies, fittings, flanges, strainers, thermometer wells, unions, pressure reducing stations, and orifice assemblies.

1.3 RELATED SECTIONS

A. Section 220529 - Hangers and Support for Plumbing Piping and Equipment

B. Section 220553 - Identification for Plumbing Piping and Equipment

C. Section 221000 - Plumbing Piping

1.4 REFERENCES

A. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

B. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form; 2023.

C. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation; 2022a.

D. ASTM C1126 - Standard Specification for Faced or Unfaced Rigid Cellular Phenolic Thermal Insulation; 2019.

E. ASTM C1136 - Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation; 2023.

F. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

G. ASTM E136 - Standard Test Method for Assessing Combustibility of Materials Using a Vertical Tube Furnace at 750 Degrees C; 2024.

H. ICC (IECC) - International Energy Conservation Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

I. SCAQMD 1168 - Adhesive and Sealant Applications; 1989, with Amendment (2022).

J. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.5 WARRANTY

A. Warrant the Work specified herein for one year against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials or workmanship.

B. Defects shall include, but not be limited to, the following:

1. Mildewing.
2. Peeling, cracking, and blistering.
3. Condensation on exterior surfaces.

1.6 SUBMITTALS

A. SHOP DRAWINGS: Indicate size, material, and finish. Show locations and installation procedures. Include details of joints, attachments, and clearances.

B. PRODUCT DATA: Submit schedules, charts, literature, and illustrations to indicate performance, fabrication procedures, project variations, and accessories.

1.7 DELIVERY AND STORAGE

A. Deliver undamaged materials in the manufacturer's unopened containers. Containers shall be clearly labeled with the insulation's flame and smoke ratings.

B. Protect insulation against dirt, water, and chemical and mechanical damage. Do not install damaged or wet insulation; remove such from project site.

PART 2 - PRODUCTS

2.1 PIPING INSULATION

A. It is the intent of these specifications to secure superior quality workmanship resulting in an absolutely satisfactory installation of insulation from the standpoint of both function and appearance. Particular attention shall be given to valves, fittings, pumps, etc., requiring low temperature insulation to ensure full thickness of insulation and proper application of the vapor seal. All flaps of vapor barrier jackets and/or canvas covering must be neatly and securely smoothed and sealed down.

B. The type of insulation and its installation shall be in strict accordance with these specifications for each service, and the application technique shall be as recommended by the manufacturer. All insulation types, together with adhesives and finishes shall be submitted and approved prior to installation.

C. A sample quantity of each type of insulation and each type of application shall be installed and approval secured prior to proceeding with the main body of the work. Condensation caused by improper installation of insulation shall be corrected by Installing Contractor. Any damage caused by condensation shall be made good at no cost to the Owner or Architect/Engineer.

D. All insulation shall be listed and labeled to have a composite (insulation, jacket or facing, and adhesive used to adhere the facing or jacket to insulation) flame spread index of not more than 25 and smoke-developed index of not more than 50 when tested in accordance with ASTM E84 or UL 723.

E. All piping insulation shall comply with minimum requirements of International Energy Conservation Code ICC (IECC) and ASHRAE Std 90.1 I-P.

F. Accessories, such as adhesives, mastics and cements shall have the same component ratings as listed above. Additionally, all adhesives and sealants used on the interior of the building (i.e., inside of the weatherproofing system and applied on-site) shall be comprised of low-emitting materials that comply with VOC limits prescribed by SCAQMD 1168.

G. All products or their shipping cartons shall have a label affixed, indicating flame and smoke ratings do not exceed the above requirements.

H. Any existing piping located in an air plenum that is comprised of materials that do not comply with the 25/50 flame and smoke rating per ASTM E84 testing requirements shall be provided with a single layer of high-temperature insulation to establish a noncombustible rating per ASTM E136. Insulation products which are approved for such non-compliant combustible piping materials located air plenums shall be 3M Fire Barrier Plenum Wrap 5A+ or Unifrax FyreWrap 0.5 Plenum. Insulation products for this application shall be installed in strict accordance with the manufacturer's instructions.

2.2 APPROVED MANUFACTURERS

A. Glass mineral wool materials shall be as manufactured by Knauf Insulation, Johns Manville or Owens-Corning and shall have the same thermal properties, density, fire rating, vapor barrier, etc., as the types specified herein, subject to review by the Engineer. All glass mineral wool insulation shall be UL GREENGUARD Gold certified.

B. Adhesives shall be as manufactured by Childers, Foster, HB Fuller or Armacell, and shall have the same adhesive properties, fire rating, vapor seal, etc., as the types specified herein, subject to review by the Engineer.

C. Flexible closed-cell elastomeric thermal insulation by Armacell.

D. Phenolic foam insulation shall be as manufactured by Resolco, Inc. (Insul-Phen) or Polyguard (Poly-phen).

E. Metal jacketing and fitting covers shall be as manufactured by Childers or RPR Products, Inc.

2.3 MATERIALS

A. INTERIOR DOMESTIC WATER PIPE: Provide pre-formed glass mineral wool pipe insulation in accordance with ASTM C547 with ASJ+ SSL+ jacket.

B. EXTERIOR DOMESTIC WATER PIPE: Provide flexible closed-cell elastomeric thermal insulation in tubular form in accordance with ASTM C534/C534M, model "AP Armaflex" with secured aluminum jacketing, or preformed phenolic foam in accordance with ASTM C1126 with secured aluminum jacketing.

C. ROOF DRAIN BODIES AND DOWNSPOUTS: Insulate underside of roof and overflow drain bodies with segmented fiberglass board in roll form with glass fibers adhered perpendicular to the vapor retarder facing. Provide insulation with factory applied FSK vapor retarder facing complying with ASTM C1136, Type II, IV, X. For associated horizontal piping, including first turn down to vertical conductor, provide glass mineral wool insulation in accordance with ASTM C547 with ASJ+ SSL+ jacket.

D. CONDENSATE AND SIMILAR DRAINAGE:

1. Condensate piping: Provide flexible closed cell elastomeric thermal insulation in tubular form in accordance with ASTM C534/C534M, model "Armaflex Ultima", fire rated for

use in environmental air plenums. Insulation is not required where piping is exposed on a roof.

2. Waste lines from water coolers and refrigerated drinking fountains to junction with main waste stacks: Insulate as described above.
3. Underside of floor drains and similar receptors receiving cooling coil condensate and the tailpieces, p-traps, and the associated piping to junction with main waste stacks: Insulate as described above.

E. ALUMINUM OR STAINLESS STEEL JACKETING: Utilize strap-on type jacketing, banding, and accessories. Provide pre-formed fitting covers for all elbows and tees.

F. ALL SERVICE JACKETING (ASJ+): Vapor retarder jacket for interior applications shall be composed of an aluminum foil layer, reinforced with glass scrim, bonded to a layer of white kraft paper, interleaving with an outer polymer film leaving no paper exposed, complying with ASTM C1136. Vapor retarder jacket for exterior applications shall be composed of a 3-ply composite membrane consisting of a white 0.5 mil polyester film, 1.0 mil aluminum foil, and one 0.5 mil clear polyester film: complying with ASTM C1136.

PART 3 - EXECUTION

3.1 GENERAL

A. All insulation shall be installed in accordance with the manufacturers' recommendations and printed installation instructions, including high density inserts at all hangers and pipe supports to prevent compression of insulation.

B. All items required for a complete and proper installation are not necessarily indicated on the plans or in the specifications. Provide all items required as per manufacturer's requirements.

C. Pipes located outdoors, in tunnels or crawlspaces shall be insulated same as concealed piping; and in addition, shall have a jacket of 0.016 inch thick, smooth aluminum with longitudinal modified Pittsburg Z-Lock seam and 2 inch overlap. Jacketing shall be easily removed and replaced without damage. All butt joints shall be sealed with gray silicone. Galvanized banding is not acceptable.

D. All insulated piping located over driveways shall have an aluminum shield permanently banded over insulation to protect it from damage from car antennas.

E. Provide all piping insulation to comply with the ASHRAE Std 90.1 I-P Minimum Thickness Schedule and as indicated below.

1. Low temperature surfaces - Minimum Insulation Thickness

    a. Exposed exterior domestic water pipe: 1-1/2 inch
    b. Interior domestic cold water pipe: 1 inch
    c. Condensate drain lines: 3/4 inch
    d. Drains receiving condensate: 1 inch
    e. Concealed piping from roof drains: 1-1/2 inch

f. Exposed piping from roof drains: 1 inch

2. Domestic Hot Water and Return Piping - Minimum Insulation Thickness

a. Pipe sizes 1-1/4 inch and smaller with operating temperatures of 140°F or less: 1 inch
b. Pipe sizes 1-1/2 inch and larger with operating temperatures of 140°F or less: 1-1/2 inch
c. Pipe sizes 1-1/4 inch and smaller with operating temperatures greater than 140°F: 1-1/2 inch
d. Pipe sizes 1-1/2 inch and larger with operating temperatures greater than 140°F: 2 inch

3.2 WATER PIPE INSULATION INSTALLATION

A. The insulation shall be applied to clean, dry pipes with all joints firmly butted together. Where piping is interrupted by fittings, flanges, valves, or hangers and at intervals not to exceed 25 feet on straight runs, a vapor dam shall be formed between the vapor retarder jacket and the bare pipe. The seal shall be by the applications of vapor retarder mastic to the exposed insulation joint faces, carried continuously down to and along 4 inches of pipe and up to and along 2 inches of jacket.

B. Pipe fittings and valves shall be insulated with pre-molded or shop fabricated glass fiber covers finished with two brush coats of vapor retarder mastic reinforced with glass fabric.

C. All under lap surfaces shall be clean and free of dust, etc. before the SSL is sealed. These laps shall be firmly rubbed to ensure a positive seal. A brush coat of vapor retarder shall be applied to all edges of the vapor retarder jacket.

D. At hangers and supports, provide a high-density foam insulation insert that extends 2” beyond the shield on each side and a protective shield/saddle to prevent compression/damage. Secure shield/saddle to insulation using mastic. Also reference specific requirements in Section 220529, Part 3 Execution.

3.3 FIRE RATED INSULATION

A. All pipe penetrations through walls and concrete floors shall be fire rated by applying Owens Corning Thermafiber in the space between the concrete and the pipe.

B. The fire rating shall be additionally sealed by using 3M brand model CP 25 or 303 fire barrier caulk and putty.

C. All fire rating material shall be insulated in accordance with manufacturer's printed instructions.

END OF SECTION 220719

SECTION 220800 - COMMISSIONING OF PLUMBING SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract Documents, including General and Supplementary Conditions and Division 01 Specifications, apply to this section.

1.2 Related SECTIONS

A. Section 019100 - General Commissioning Requirements

B. Section 230963 - Energy Management and Control System (EMCS)

1.3 SUMMARY

A. The commissioning of the plumbing system and associated controls shall be performed by an impartial technical firm hired by the owner. The commissioning provider shall be certified under one or more of the following certifications:

1. CxA - Certified Commissioning Authority - ACG

    a. CBCP - Certified Building Commissioning Professional - AEE
    b. CCP - Certified Commissioning Professional - BCA
    c. CPMP - Certified Process Management Professional - ASHRAE
    d. BSC - Building System Commissioning Certification - NEBB

B. The commissioning provider (Commissioning authority) shall be responsible for leading the entire construction team through the commissioning process including, but not limited to, conducting the commissioning kick-off meeting, preparing the commissioning plan, preparing pre-functional checklists, preparing functional test scripts, participation in functional testing and preparation of required documentation and reports.

1.4 RESPONSIBILITIES

A. Contractor: Responsibilities of the Contractor as related to the Commissioning Process include, but are not limited to the following:

1. Facilitate coordination of Commissioning work by Commissioning authority.
2. Attend Commissioning meetings or other meetings called by Commissioning authority to facilitate the Commissioning Process.
3. Review Functional Performance Test procedures for feasibility, safety, and impact on warranty, and provide Commissioning authority with written comment on same.

4. Provide all documentation relating to manufacturer's recommended performance testing of equipment and systems.
5. Provide Operations & Maintenance data to Commissioning Authority for preparation of checklists and training manuals.
6. Provide As-built drawings and documentation to facilitate Testing.
7. Assure and facilitate participation and cooperation of Sub Contractors and equipment suppliers as required for the Commissioning Process.
8. Certify to Commissioning authority that installation work listed in Pre-Functional Checklists has been completed.
9. Install systems and equipment in strict conformance with project specifications, manufacturer's recommended installation procedures, and Pre-Functional Checklists.
10. Provide data concerning performance, installation, and start-up of systems.
11. Provide copy of manufacturers filled-out start-up forms for equipment and systems.
12. Ensure systems have been started and fully checked for proper operation prior to arranging for Testing with Commissioning authority. Prepare and submit to Commissioning authority **written** certification that each piece of equipment and/or system has been started according to manufacturer's recommended procedure, and that system has been tested for compliance with operational requirements.

    a. Contractor shall carry out manufacturer's recommended start-up and testing procedures, regardless of whether or not they are specifically listed in Pre-Functional Checklists.
    b. Contractor is not relieved of obligation for systems/equipment demonstration where performance testing is required by specifications, but a Functional Performance Test is not specifically designated by Commissioning authority.

13. Coordinate with Commissioning authority to determine mutually acceptable date of Functional Performance Tests.
14. Provide qualified personnel to assist and participate in Commissioning.
15. Provide test instruments and communications devices, as prescribed by Commissioning authority, required for carrying out Testing of systems.
16. Proprietary test equipment required by the manufacturer, whether specified or not, shall be provided by the manufacturer of the equipment. Manufacturer shall provide the test equipment, demonstrate its use, and assist in the commissioning process. Proprietary test equipment shall become the property of the Owner upon completion of commissioning.
17. Ensure deficiencies found in the Commissioning Issues Log are corrected within the time schedule shown in the Commissioning Plan.
18. Provide Commissioning authority with all submittals, start-up instructions manuals, operating parameters, and other pertinent information related to Commissioning Process. This information shall be routed through Architect.
19. Provide commissioning authority with a certificate of readiness to show systems are ready to schedule functional testing.
20. Prepare and submit to Commissioning authority proposed Training Program outline for each system.
21. Coordinate and provide training of Owner's personnel.
22. Prepare Operation & Maintenance Manuals and As-Built drawings in accordance with specifications; submit copy to Commissioning authority in addition to other contractually required submissions. Revise and resubmit manuals in accordance with Design Professionals and Commissioning authority comments.

23. Commissioning requires participation of this Division Subcontractors to ensure that systems are operating in manner consistent with Contract Documents. All costs associated with the participation of Contractor, Sub-Contractors, Design Professionals, and Equipment Vendors in the Commissioning Process shall be included as part of the Construction Contract.

B. Subcontractors and vendors shall prepare and submit to Commissioning authority proposed Startup procedures to demonstrate proper installation of systems, according to these specifications and checklists prepared by Commissioning authority

1.5 COMMISSIONING PLAN

A. Commissioning Process tasks and activities:

1. Commissioning kick-off meeting: Conducted by commissioning authority and attended by construction team and design team.
2. Pre-functional checklists: Prepared by the commissioning authority and filled out by subcontractors performing the work that is applicable.
3. Site visits to review installation of applicable systems and progress of checklist documentation performed and reported by commissioning authority.
4. Functional testing: Commissioning authority shall conduct functional testing with assistance of applicable subcontractors and document successful results as well as deficiencies (issues). Functional performance testing shall demonstrate the installation and operation of components, systems, and system-to-system interfacing in accordance with plans and specifications. Testing shall include all modes and sequence of operation, including under full-load, part-load and emergency conditions (including all alarms). Controls system shall be tested to document that control devices, components, equipment and systems are calibrated and adjusted and operate in accordance with the plans and specifications. Sequences shall be functionally tested to document they operate in accordance with plans and specifications.
5. Preliminary commissioning report: Commissioning authority shall issue a preliminary commissioning report to the owner that has results of the first round of functional testing including deficiencies discovered.
6. Systems manual: Commissioning authority shall compile the systems manual using submittal data provided by the general contractor and applicable subcontractors.
7. Final commissioning report: Commissioning authority shall issue final commissioning report documenting the entire process and final results of functional testing. Report shall include final testing and balancing report.

B. Equipment to be tested

1. Energy Management and Control System interface with applicable plumbing system equipment.
2. Service water heating systems (100%).
3. Service water circulation equipment (100%).
4. Domestic water booster pumps (100%).

C. Testing functions and conditions

1. Verify shutdown of systems when scheduled.
2. Calibration of sensors
3. Confirm functionality of all specified sequences of operations.
4. Verify the functionality of all alarms.

D. Performance criteria

1. Water temperatures shall be within tolerances specified in the contract documents.
2. Water heating system “recovery” rates shall be within specified time frame.
3. Booster pump shall maintain system pressure within specified tolerance.

PART 2 - PRODUCTS

2.1 NO PRODUCTS SUPPLIED

PART 3 - EXECUTION

3.1 GENERAL

A. This Division has startup responsibilities and are required to complete sub-systems so COMPLETE SYSTEMS are fully functional. Insuring they meet design requirements of Contract Documents. Commissioning procedures and testing do not relieve or lessen this responsibility or shift this responsibility, in whole or in part, to Commissioning Agent or Owner.

B. Coordinate with other Sub-Contractors and equipment vendors to set aside adequate time to address Pre-Functional Checklists, Functional Performance Tests, Operations & Maintenance Manual creation, Owner Training, and associated coordination meetings.

C. Commissioning authority will also conduct site inspections at critical times and issue Cx Field Reports with observations on installation deficiencies so that they may be issued by Architect as deemed appropriate.

3.2 WORK PRIOR TO COMMISSIONING

A. Complete all phases of the work so the systems can be started, adjusted, balanced, tested, and otherwise tested.

B. See pertinent specification sections in this Division, which outline responsibilities for start-up of equipment with obligations to complete systems, including all sub-systems so that they are fully functional.

C. Assist commissioning authority with all information pertaining to actual equipment and installation as required complete the full commissioning scope.

D. Contractor shall prepare startup procedures to demonstrate compliance with pre-functional checklists, and coordinate scheduling for completion of these checklists.

E. A minimum of 7 days prior to date of system startup, submit to Commissioning authority for review, detailed description of equipment start-up procedures which contractor proposes to perform to demonstrate conformance of systems to specifications and Checklists.

3.3 PARTICIPATION IN COMMISSIONING

A. Attend meetings related to the Commissioning Process; arrange for attendance by personnel and vendors directly involved in the project, prior to testing of their systems.

B. Provide skilled technicians to startup and test all systems, and place systems in complete and fully functioning service in accordance with Contract Documents.

C. Provide skilled technicians, experienced and familiar with systems being commissioned, to assist Commissioning authority in commissioning process.

3.4 WORK TO RESOLVE DEFICIENCIES

A. Complete corrective work in a timely manner to allow expeditious completion of Commissioning Process. If deadlines pass without resolution of identified problems, Owner reserves the right to obtain supplementary services and/or equipment to resolve the problem. Costs thus incurred will be Contractor’s responsibility.

3.5 PRE-FUNCTIONAL CHECKLISTS (PFC)

A. Contractor shall complete Pre-Functional Checklists to validate compliance with Contract Documents installation and start-up requirements, for this Division’s systems.

B. Refer to commissioning plan for detailed list of equipment to be commissioned.

3.6 FUNCTIONAL PERFORMANCE TESTING (FPT)

A. Contractor, in cooperation with Commissioning Agent, shall conduct Functional Performance Testing to validate compliance with Contract Documents.

B. Refer to commissioning plan for detailed list of equipment to be commissioned.

C. Provide commissioning authority with a certificate of readiness to show systems are ready to schedule functional testing.

D. Assist Commissioning authority in Functional Testing by removing equipment covers, opening access panels, etc. Furnish ladders, flashlights, meters, gauges, or other inspection equipment, as necessary.

E. Sampling

1. Multiple identical pieces of non-life-safety or otherwise non-critical equipment may be functionally tested using a sampling strategy.
2. Significant application differences and significant sequence of operation differences in otherwise identical equipment invalidates their common identity. A small size or capacity difference, alone, does not constitute a difference. It is noted that no sampling by Subs is allowed in pre-functional checklist execution.
3. A common sampling strategy is the "xx% Sampling - yy% Failure Rule", defined by the following example.

    a. xx = the percentage of the group of identical equipment to be included in each sample.
    b. yy = the percentage of the sample that if failing, will require another sample to be tested.
    c. The example below describes a 20% Sampling - 10% Failure Rule.
    d. Randomly test at least 20% (xx) of each group of identical equipment. In no case test less than three units in each group. This 20%, or three, constitute the "first sample."
    e. If 10% (yy) of the units in the first sample fail the functional tests, test another 20% of the group (the second sample).
    f. If 10% of the units in the second sample fail, test all remaining units in the whole group.
    g. If at any point, frequent failures are occurring and testing is becoming more troubleshooting than verification, the CxA may stop the testing and require the responsible Sub to perform and document a checkout of the remaining units, prior to continuing with functionally testing the remaining units.

F. Re-Testing and Failure To Remedy Deficiencies

1. Despite Contractor's best efforts to ensure systems are problem-free, it is expected that some deficiencies will be found during initial inspection of Pre-functional Checklist, and during initial Functional Testing; such deficiencies are expected to be minimal.
2. It is Contractor's responsibility to remedy identified deficiencies, both in Pre-functional Checklist and in Functional Testing phases of work, in a timely and thorough manner.
3. It is Contractor's responsibility to ensure that all deficiencies are corrected prior to requesting a re-inspection or re-test of systems and equipment. Do not request re-inspection or re-test until deficiencies are corrected.

    a. At his discretion, CxA may agree to re-testing systems or equipment where deficiencies remain which are beyond Contractor's control to resolve expeditiously.
    b. Typically such re-testing of incomplete systems and equipment will take place only if remaining deficiencies are minor in scope and nature, and are of such nature that they cannot be resolved in a timely manner (such as those due to difficulties in obtaining parts, or where Owner has requested a change that has delayed work, etc.)

4. CxA will carry out a second re-inspection or re-test of systems and equipment subsequent to receiving Contractor's request.

a. If CxA finds deficiencies identified in initial inspection or test have not been remedied (with exception of un-resolvable deficiencies in 3.b. above), and such remaining deficiencies are significant enough to require additional inspection or re-testing, Contractor will be back-charged for CxA's expenses, and time at a rate of $150.00 per hour and $100.00 expenses, for a third and any subsequent re-inspections and re-tests.

G. Deferred Testing

1. "Seasonal Commissioning" pertains to testing during peak heating or cooling seasons when HVAC equipment is operating at full-load or heavy-load conditions. Initial commissioning will be done as soon as contract work is completed, regardless of season. Seasonal Commissioning under full- or heavy-load conditions other than the current season will be handled at later time by GC and CxA.
2. If adequate load may be artificially placed upon heating or cooling equipment, CxA, at his discretion, may perform functional testing during non-peak load periods.
3. GC is to provide services of personnel and participate in seasonal testing process in the same manner as he would in non-seasonal testing.
4. Until off-season commissioning can be accomplished, Owner may retain an amount from GC's payment sufficient to cover the cost of off-season testing.
5. Unforeseen Deferred Tests: If any check or test cannot be completed due to building structure, required occupancy condition, or other reason, execution of checklists and functional testing may be delayed upon approval of Owner. Tests shall be conducted in same manner as seasonal tests, as soon as possible. Services of required parties will be negotiated. Make final adjustments to Operation and Maintenance Manuals and record drawings due to unforeseen deferred tests.
6. GC is to provide services of personnel and participate in deferred testing in the same manner as he would for normal commissioning.

3.7 TRAINING

A. The following requirements are in addition to Operations & Maintenance requirements specified elsewhere in this specification's manual.

B. Contractor shall be responsible for training coordination and scheduling, and ultimately to ensure that training is completed.

C. The training agenda (plan) shall include, at a minimum, the following elements:

1. Purpose of equipment.
2. Principle of how the equipment works.
3. Important parts and assemblies.
4. How the equipment achieves its purpose and necessary operating conditions.
5. Most likely failure modes, causes and corrections.
6. On site demonstration.

D. Commissioning authority shall be responsible for overseeing and approving content and adequacy of training of Owner personnel for all installed systems. Provide Commissioning authority with training plan two weeks before planned training.

3.8 OPERATIONS & MAINTENANCE MANUALS

A. The following requirements are in addition to Operations & Maintenance requirements specified elsewhere in this specification's manual.

B. Sub-Contractor shall compile and prepare documentation for equipment and systems specified in this Division and shall deliver documentation to Contractor for inclusion in Operation & Maintenance Manuals, in accordance with requirements of Division 01, prior to training Owner personnel.

C. Provide Commissioning authority with a single, electronic copy of Operation & Maintenance Manuals for review. Commissioning authority copy of O&M manuals shall be submitted through Architect.

D. Operation and maintenance manuals shall include service agency contact information, maintenance requirements, controls system settings and a narrative of how each system is intended to operate, including set points.

3.9 DOCUMENTATION

A. Commissioning authority shall provide documentation of process as follows:

1. Preliminary commissioning report including test procedures, results of testing, itemization of deficiencies, deferred tests and climatic conditions required for performance of deferred tests. Preliminary commissioning report shall be issued to owner to demonstrate the first pass of testing has occurred and to demonstrate compliance with applicable codes.
2. Final commissioning report shall include the final test and balance report, final results of functional testing, disposition of deficiencies discovered during testing, including the details of corrective measures used and functional testing procedures used for repeatability of testing in the future.

END OF SECTION 220800

SECTION 221000 - PLUMBING PIPING

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

B. The Basic Materials and Methods, Section 220200, are included as a part of this Section as though written in full in this document.

1.2 SCOPE

A. The scope of the work shall include the furnishing and complete installation of the piping covered by this Section, with all appurtenances, ready for the Owner's use.

B. Include the following work in addition to items normally part of this Section:

1. Pipe and pipe fittings:

    a. Sanitary drainage piping system.
    b. Storm drainage piping system.
    c. Domestic water piping system.

2. Adapters, Transitions, Unions, Couplings, Flanges, Connectors
3. Valves
4. Excavation, Bedding, and Backfill

1.3 RELATED WORK

A. Section 220529 - Hangers and Support for Plumbing Piping and Equipment

B. Section 220548 - Vibration and Seismic Controls for Plumbing Piping

C. Section 220553 - Identification for Plumbing Piping and Equipment

D. Section 220719 - Plumbing Piping Insulation

E. Section 221112 - Domestic Water Piping - Cross-Linked Polyethylene (PEX) for Institutional Facilities

F. Section 221119 - Plumbing Specialties

G. Section 223000 - Plumbing Equipment

H. Section 224000 - Plumbing Fixtures

1.4 REFERENCES

A. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250; 2020.

B. ASME B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard; 2020.

C. ASME B16.14 - Ferrous Pipe Plugs, Bushings, and Locknuts with Pipe Threads; Current Edition.

D. ASME B16.15 - Cast Copper Alloy Threaded Fittings: Classes 125 and 250; 2024.

E. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2021.

F. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2021.

G. ASME B16.23 - Cast Copper Alloy Solder Joint Drainage Fittings: DWV; 2021.

H. ASME B16.24 - Cast Copper Alloy Pipe Flanges, Flanged Fittings, and Valves: Classes 150, 300, 600, 900, 1500, and 2500; 2021.

I. ASME B16.29 - Wrought Copper and Wrought Copper Alloy Solder-Joint Drainage Fittings—DWV; 2022.

J. ASME B16.39 - Malleable Iron Threaded Pipe Unions: Classes 150, 250, and 300; 2019.

K. ASME B16.50 - Wrought Copper and Copper Alloy Braze-Joint Pressure Fittings; 2013.

L. ASME B16.51 - Copper and Copper Alloy Press-Connect Pressure Fittings; Current Edition.

M. ASME BPVC - Boiler and Pressure Vessel Code; 2023.

N. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators; 2023.

O. ASSE 1079 - Performance Requirements for Dielectric Pipe Unions; 2012.

P. ASTM A74 - Standard Specification for Cast Iron Soil Pipe and Fittings; 2021.

Q. ASTM A312/A312M - Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes; 2022a.

R. ASTM A403/A403M - Standard Specification for Wrought Austenitic Stainless Steel Piping Fittings; 2022b.

S. ASTM A536 - Standard Specification for Ductile Iron Castings; 1984, with Editorial Revision (2019).

T. ASTM A582/A582M - Standard Specification for Free-Machining Stainless Steel Bars; 2022.

U. ASTM A733 - Standard Specification for Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples; 2016 (Reapproved 2022).

V. ASTM A865/A865M - Standard Specification for Threaded Couplings, Steel, Black or Zinc-Coated (Galvanized) Welded or Seamless, for Use in Steel Pipe Joints; 2023.

W. ASTM A888 - Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications; 2020.

X. ASTM B1 - Standard Specification for Hard-Drawn Copper Wire; 2013 (Reapproved 2018).

Y. ASTM B3 - Standard Specification for Soft or Annealed Copper Wire; 2013 (Reapproved 2018).

Z. ASTM B32 - Standard Specification for Solder Metal; 2020.

AA. ASTM B43 - Standard Specification for Seamless Red Brass Pipe, Standard Sizes; 2020.

BB. ASTM B75/B75M - Standard Specification for Seamless Copper Tube; 2020.

CC. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2022.

DD. ASTM B306 - Standard Specification for Copper Drainage Tube (DWV); 2020.

EE. ASTM B828 - Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings; 2023.

FF. ASTM C564 - Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings; 2020a.

GG. ASTM C1053 - Standard Specification for Borosilicate Glass Pipe and Fittings for Drain, Waste, and Vent (DWV) Applications; 2000 (Reapproved 2015).

HH. ASTM C1173 - Standard Specification for Flexible Transition Couplings for Underground Piping Systems; 2018.

II. ASTM C1460 - Standard Specification for Shielded Transition Couplings for Use with Dissimilar DWV Pipe and Fittings Above Ground; 2017.

JJ. ASTM C1540 - Standard Specification for Heavy-Duty Shielded Couplings Joining Hubless Cast Iron Soil Pipe and Fittings; 2020.

KK. ASTM C1540 - Standard Specification for Heavy-Duty Shielded Couplings Joining Hubless Cast Iron Soil Pipe and Fittings; 2020.

LL. ASTM D635 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position; 2022.

MM. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)); 2012 (Reapproved 2021).

NN. ASTM D1248 - Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable; 2016.

OO. ASTM D1599 - Standard Test Method for Resistance to Short-Time Hydraulic Pressure of Plastic Pipe, Tubing, and Fittings; 2018.

PP. ASTM D1784 - Standard Classification System and Basis for Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds; 2020.

QQ. ASTM D1785 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120; 2021a.

RR. ASTM D2122 - Standard Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings; 2022.

SS. ASTM D2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications; 2020.

TT. ASTM D2466 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40; 2023.

UU. ASTM D2564 - Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems; 2020.

VV. ASTM D2665 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings; 2020.

WW. ASTM D2774 - Standard Practice for Underground Installation of Thermoplastic Pressure Piping; 2021a.

XX. ASTM D2855 - Standard Practice for the Two-Step (Primer and Solvent Cement) Method of Joining Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Piping Components with Tapered Sockets; 2020.

YY. ASTM D3034 - Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings; 2023.

ZZ. ASTM D3139 - Standard Specification for Joints for Plastic Pressure Pipes using Flexible Elastomeric Seals; 2019.

AAA. ASTM D3212 - Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals; 2007.

BBB. ASTM D3222 - Standard Specification for Unmodified Poly (Vinylidene Fluoride) (PVDF) Molding Extrusion and Coating Materials; 2021.

CCC. ASTM D3311 - Standard Specification for Drain, Waste, and Vent (DWV) Plastic Fittings Patterns; 2017 (Reapproved 2021).

DDD. ASTM D4101 - Standard Classification System and Basis for Specification for Polypropylene Injection and Extrusion Materials; 2017, with Editorial Revision (2019).

EEE. ASTM D4976 - Standard Specification for Polyethylene Plastics Molding and Extrusion Materials; 2012.

FFF. ASTM D5926 - Standard Specification for Poly (Vinyl Chloride) (PVC) Gaskets for Drain, Waste, and Vent (DWV), Sewer, Sanitary, and Storm Plumbing Systems; 2015.

GGG. ASTM D6707/D6707M - Standard Specification for Circular-Knit Geotextile for Use in Subsurface Drainage Applications; 2016.

HHH. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

III. ASTM E438 - Standard Specification for Glasses in Laboratory Apparatus; 1992 (Reapproved 2018).

JJJ. ASTM F439 - Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80; 2019.

KKK. ASTM F441/F441M - Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80; 2023.

LLL. ASTM F477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe; 2014 (Reapproved 2021).

MMM. ASTM F493 - Standard Specification for Solvent Cements for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe and Fittings; 2022.

NNN. ASTM F656 - Standard Specification for Primers for Use in Solvent Cement Joints of Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings; 2021.

OOO. ASTM F1290 - Standard Practice for Electrofusion Joining Polyolefin Pipe and Fittings; 2019.

PPP. ASTM F1412 - Standard Specification for Polyolefin Pipe and Fittings for Corrosive Waste Drainage Systems; 2016.

QQQ. ASTM F1476 - Standard Specification for Performance of Gasketed Mechanical Couplings for Use in Piping Applications; 2007 (Reapproved 2019).

RRR. ASTM F1548 - Standard Specification for Performance of Fittings for Use with Gasketed Mechanical Couplings Used in Piping Applications; 2001.

SSS. ASTM F1673 - Standard Specification for Polyvinylidene Fluoride (PVDF) Corrosive Waste Drainage Systems; 2010, with Editorial Revision (2021).

TTT. ASTM F2618 - Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Fittings for Chemical Waste Drainage Systems; 2019.

UUU. AWS A5.9/A5.9M - Welding Consumables-Wire Electrodes, Strip Electrodes, Wires, and Rods for Arc Welding of Stainless and Heat Resisting Steels- Classification; 2017.

VVV. AWWA C105/A21.5 - Polyethylene Encasement for Ductile-Iron Pipe Systems; 2018.

WWW. AWWA C110/A21.10 - Ductile-Iron and Gray-Iron Fittings; 2021.

XXX. AWWA C111/A21.11 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings; 2023.

YYY. AWWA C151/A21.51 - Ductile-Iron Pipe, Centrifugally Cast; 2023.

ZZZ. AWWA C209 - Tape Coatings for Steel Water Pipe and Fittings; 2019.

AAAA. AWWA C219 - Bolted Sleeve-Type Couplings for Plain-End Pipe; 2023.

BBBB. AWWA C509 - Resilient-Seated Gate Valves for Water Supply Service; 2023.

CCCC. AWWA C515 - Reduced-Wall, Resilient-Seated Gate Valves for Water Supply Service; 2020.

DDDD. AWWA C600 - Installation of Ductile-Iron Mains and Their Appurtenances; 2023.

EEEE. AWWA C651 - Disinfecting Water Mains; 2023.

FFFF. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. through 60 In. (100 mm through 1500 mm); 2022.

GGGG. CISPI 301 - Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications; 2021.

HHHH. CISPI 310 - Specification for Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications; 2020.

IIII. FM 1680 - Approval Standard for Couplings Used in Hubless Cast Iron Systems for Drain, Waste or Vent, Sewer, Rainwater or Storm Drain Systems Above and Below Ground, Industrial/ Commercial and Residential; 1989.

JJJJ. NFPA 13 - Standard for the Installation of Sprinkler Systems; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

KKKK. NFPA 20 - Standard for the Installation of Stationary Pumps for Fire Protection; 2025.

LLLL. NFPA 24 - Standard for the Installation of Private Fire Service Mains and Their Appurtenances; 2025.

MMMM. UL 94 - Tests for Flammability of Plastic Materials for Parts in Devices and Appliances; Current Edition, Including All Revisions.

NNNN. UL 1285 - Safety Pipe and Couplings, Polyvinyl Chloride (PVC), and Oriented Polyvinyl Chloride (PVCO) for Underground Fire Service; 2016.

1.5 QUALITY ASSURANCE

A. Manufacturer: For each product specified, provide components by the same manufacturer throughout.

B. Valves: Manufacturer's name, size, and pressure rating shall be cast or marked on valve body or handle.

C. Piping shall be labeled along its entire length indicating size, class, material specification, manufacturer’s name and country of origin.

D. Foreign pipe, fittings or valves are unacceptable.

E. All cast iron soil pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute (CISPI) and shall be listed by NSF International.

F. Welding Materials and Procedures: Conform to ASME BPVC and applicable state labor regulations.

G. Welders Certification: In accordance with ASME BPVC-IX.

1.6 SUBMITTALS

A. Submit under provisions of Division One.

B. Submit product data and video inspection report under provisions of Division One.

C. Include pipe materials, pipe fittings, valves, and accessories. Provide manufacturer’s catalog information, product certifications, and country of origin. Indicate valve data and ratings.

D. Submit dimensioned detailed drawings and material specifications for pipe isolation and protection systems being provided for void form/carton form/void box installations.

1.7 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Division One.

B. Record actual locations of valves.

C. Include written report and digital video record of waste piping inspection.

1.8 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Division One.

B. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

1.9 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with a minimum of 5 years documented experience and must be a domestic manufacturer.

B. Installer: Company specializing in performing the work of this section with a minimum of 5 years documented experience.

1.10 DELIVERY, STORAGE, AND HANDLING

A. DELIVERY: Deliver clearly labeled piping and valves to; and store, protect and handle products on site in accordance with the provisions of Division One.

B. TIMING AND COORDINATION: Arrange for delivery of materials to allow for minimum storage time at the project site. Coordinate with the scheduled time of installation.

C. ACCEPTANCE: Accept product on site in original factory packaging. Receive valves on site in shipping containers with labeling in place. Inspect for damage. Damaged valves shall not be acceptable.

D. STORAGE: Store materials in a clean, dry location, protected from weather and damage.

E. Provide temporary protective coating on cast iron and steel valves.

F. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

G. Protect installed piping systems from entry of foreign materials by providing temporary covers, as completing sections of the work, and isolating parts of completed systems. Tape will not be allowed as an acceptable end cover.

1.11 EXTRA MATERIALS

A. Furnish under provisions of Division One.

1.12 REGULATORY REQUIREMENTS

A. Perform work in accordance with plumbing and building codes having jurisdiction.

B. PVC pipe, fittings, or similar un-rated material shall not be installed in a return air plenum unless the entire length of all such piping is encased within a minimum two (2) hour fire rated enclosure.

C. Provide water pressure regulating valves:

1. At the service entry where incoming water supply pressure is greater than 70 psi.
2. Anywhere else in the distribution system where delivered water pressure is excessive relative to the fixture or equipment it serves, based on the fixture or equipment manufacturer's recommendations. Examples may include dish machines, booster heaters, food waste disposers, etc.

PART 2 - PRODUCTS

2.1 SANITARY SOIL, WASTE AND VENT PIPING, BURIED WITHIN 5 FEET OF BUILDING

A. PVC Pipe: ASTM D1785 / ASTM D2665 schedule 40 solid wall; installed per ASTM D2321.

1. Fittings: PVC, ASTM D3311 / ASTM D2665 drainage pattern, with bell and spigot ends. Furnished by the same manufacturer as pipe or approved equal.
2. Joints: solvent weld with ASTM D2564 solvent cement, clear, medium bodied, for sizes 3" and smaller and gray, heavy bodied, for sizes 4" and larger. Mating surfaces shall be prepared with ASTM F656 purple primer immediately prior to cement application.

2.2 SANITARY SOIL, WASTE AND VENT PIPING, WITHIN BUILDING, NOT BURIED

A. Cast Iron Pipe: CISPI 301 or ASTM A888, hubless.

1. Fittings: Cast iron, CISPI 301 or ASTM A888 drainage pattern.
2. Acceptable manufacturers (all pipe and fittings shall be from a single manufacturer):

    a. Tyler Pipe
    b. Charlotte Pipe
    c. AB&I Foundry

3. Pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute and shall be listed by NSF International.
4. Joints: No hub heavy-duty, shielded, stainless steel couplings meeting ASTM C1540 and FM 1680 Class 1. Complete with minimum 304 stainless steel bands, tightening devices, and shield (minimum 0.015 shield thickness). ASTM C564 neoprene gasket. Made in the USA. Torque all clamps per manufacturer's recommendations. Acceptable manufacturers:

    a. Husky SD 4000
    b. Clamp-All 125

B. Copper Tubing: ASTM B306, DWV, for sizes 2" and smaller.

1. Fittings: ASME B16.23 cast copper alloy solder joint drainage fittings (DWV), or ASME B16.29, wrought copper and wrought copper alloy solder joint drainage fittings (DWV).
2. Joints between copper pipe and fittings shall be made in accordance with ASTM B828 using ASTM B32 Alloy Grade Sn 50 solder (50-50 tin-lead).
3. Joints between copper and cast iron pipe shall be made by way of copper soldered to a brass ferrule and the ferrule joined to the cast iron hub by a compression or caulked joint.

2.3 STORM DRAINAGE PIPING, BURIED WITHIN 5 FEET OF BUILDING

A. PVC Pipe: ASTM D1785 / ASTM D2665 schedule 40 solid wall; installed per ASTM D2321.

1. Fittings: PVC, ASTM D3311 / ASTM D2665 drainage pattern, with bell and spigot ends. Furnished by the same manufacturer as pipe or approved equal.
2. Joints: solvent weld with ASTM D2564 solvent cement, installed per the requirements of ASTM D2855.

2.4 STORM DRAINAGE PIPING, WITHIN BUILDING, not buried

A. Cast Iron Pipe: CISPI 310 or ASTM A888, hubless.

1. Fittings: Cast iron, CISPI 310 or ASTM A888 drainage pattern.
2. Acceptable manufacturers (all pipe and fittings shall be from a single manufacturer):

a. Tyler Pipe
b. Charlotte Pipe
c. AB&I Foundry

3. Pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute and shall be listed by NSF International.
4. Joints: No hub heavy-duty, shielded, stainless steel couplings meeting ASTM C1540 and FM 1680 Class 1. Complete with minimum 304 stainless steel bands, tightening devices, and shield (minimum 0.015 shield thickness). ASTM C564 neoprene gasket. Made in the USA. Torque all clamps per manufacturer's recommendations. Acceptable manufacturers:

a. Husky SD 4000
b. Clamp-All 125

2.5 DOMESTIC WATER PIPING, WITHIN BUILDING, buried

A. Copper Tubing: ASTM B88, Type K, soft annealed.

1. No joints allowed buried, run tubing continuous.
2. Provide AWWA C209 cold-applied, integrated primer type, elastomeric adhesive, laminate polymeric tape coating, minimum 35 mil nominal thickness, in accordance with manufacturer’s installation guidelines, for all piping buried or in contact with concrete, to a minimum of 6" above finished floor. Chase Construction Products Tapecoat H35 or approved equivalent.
3. Applies to installations including services to island sinks and trap primer lines.
4. Also provide protection from concrete for copper piping at penetrations through elevated decks.

2.6 DOMESTIC WATER PIPING, WITHIN BUILDING, not buried

A. Copper Tubing: ASTM B88, Type L, hard drawn.

1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22 wrought copper alloy solder joint pressure fittings.
2. Joints between copper pipe and fittings shall be made in accordance with ASTM B828 using ASTM B32 Alloy HB lead-free solder.
3. Fittings and joints for pipe sizes 1/2" through 4" may be mechanical press-connect system joints with ASME B16.51 lead-free copper bodied fittings with integral ethylene-propylene diene monomer rubber (EPDM) sealing gaskets. All fittings, couplings, and adapters shall be the product of a single system manufacturer and only that manufacturer's approved press tools, kits, and jaws shall be used.

    a. EPDM o-rings shall be pre-installed and lubricated with NSF 61 listed lubricant.
    b. All installers of copper press-connect fittings shall be trained by the fitting manufacturer's appointed representative and carry such credentials for the duration of the project.
    c. The fitting manufacturer's representative shall conduct periodic inspections of the installation and shall provide written reports of such inspections to the Contractor and Engineer, including any observed deviations from the manufacturer's recommended installation practices.
    d. Acceptable system manufacturers: Viega only.
    e. Fittings used must be crimped on either side of O-ring seal. Single crimp fittings are specifically not approved per district standards.

2.7 ADAPTERS, TRANSITIONS, UNIONS, COUPLINGS, FLANGES, CONNECTORS

A. (Non-Acid Waste) Drainage Applications:

1. Provide approved listed adapter and transition fittings appropriate to the specific pipe transition and in accordance with code requirements.
2. **Not buried:** For dissimilar piping not buried, provide stainless steel shielded, molded elastomeric couplings and adapters meeting ASTM C564 and ASTM C1460. Applies to installations including cast iron to PVC transitions immediately adjacent to the building floor where piping below is buried.

    a. Husky 4200 or Cremco
    b. Fernco Proflex

3. **Buried, but NOT below building slab**: For dissimilar buried piping beyond the limits of building or readily accessible buried piping transitions in backwater valve pits, etc. Provide shear resistant .012" thick 300 series stainless steel shielded, **PVC gasketed** flexible couplings and adapters meeting ASTM D5926 and ASTM C1173. For direct-bury applications, provide AWWA C209 cold-applied, integrated primer type, elastomeric adhesive, laminate polymeric tape coating, minimum 35 mil nominal thickness, in accordance with manufacturer's installation guidelines, to completely wrap the shield, banding, and screws. Chase Construction Products Tapecoat H35 or approved equivalent.

    a. Cremco
    b. Mission Rubber Company, LLC
    c. Fernco, Inc. Strong Back RC 1000 Series

4. Adapters, couplings, bushings for copper DWV pipe shall be cast bronze or wrought copper, ASME B16.23 / ASME B16.29.

B. Domestic Water Applications:

1. Provide joints between various materials with approved adapter and transition fittings appropriate to the specific pipe transition and in accordance with code requirements and the manufacturer's instructions.
2. For copper tube and pipe: adapters, bushings, plugs, caps, and couplings shall be wrought copper or cast bronze; flanges (minimum class 150) and unions shall be cast bronze. Provide with solder or threaded connections as necessary and as produced to applicable standards ASME B16.15, ASME B16.18, ASME B16.22, ASME B16.24, ASME B16.50 ASME B16.50, ASME B1.20.1. All such appurtenances shall be for use in above ground potable water systems.
3. Buried to not buried transitions for water service entries:

    a. 100% fusion bonded epoxy coated ASTM A536 cast ductile iron construction coupling with acrylonitrile butadiene rubber (NBR) gaskets and EPDM insulating boot for water service. 5/8 inch high strength stainless steel bolts and nuts. Coupling shall meet AWWA C219. Romac Industries, Inc. IC501 or pre-approved equivalent.
    b. 100% fusion bonded 14 mil epoxy coated coupling with ASTM A536 cast ductile iron rings. Complete with acrylonitrile butadiene rubber (NBR) gaskets and type 304 stainless steel bridge, spacers, nuts, and bolts. Coupling shall meet AWWA C219, NSF 61, and NSF 372. Krausz USA Hymax Grip Coupling Restraint or pre-approved equivalent.

4. Dielectric connections:

    a. For pipe sizes 2 inch and smaller, provide lead-free dielectric unions, rated to 180 F at 250 psi and compliant to ASSE 1079.
    b. For pipe sizes larger than 2 inches, provide lead-free dielectric flanged pipe fittings, rated to 180 F at 175 psi and meeting ASME B16.1.
    c. For grooved copper joining systems, provide grooved end dielectric transition fitting from system manufacturer, with virgin polypropylene internal lining, meeting NSF 61.

C. General:

1. Unions for ferrous pipe shall be ASME B16.39 galvanized malleable iron, threaded, minimum pressure class 150.
2. Plugs and bushings for ferrous pipe shall be ASME B16.14 galvanized malleable iron, threaded.
3. Nipples for ferrous pipe shall be schedule 40, galvanized, ASTM A53/A53M welded steel pipe nipples, threaded, meeting ASTM A733.
4. Couplings for ferrous pipe shall be galvanized steel, threaded, manufactured in accordance with ASTM A865/A865M.
5. Flanges for ferrous pipe shall be galvanized forged steel construction, either socket weld or slip-on weld type, minimum pressure class 150, manufactured to ASME B16.5.

6. Bolts, nuts, and gaskets for flanged connections shall be appropriate to the pipe material, fluid type, temperature, and pressure. 1/16" thick pre-formed neoprene, typical.
7. Provide flexible stainless steel connectors at pumps and other such equipment, in accordance with manufacturer's recommendations. Connectors shall have corrugated hose and braided 300 series stainless steel jacketing. Carbon steel flanged or grooved ends as appropriate. NSF 372 lead-free for all potable water applications. Metraflex Company or pre-approved equivalent.

2.8 BALL VALVES

A. All bronze cast construction two-piece 600 psi body, blow-out proof stem, Teflon seated, lead-free, with stainless steel trim (including ball, stem, and valve handle). Threaded connections. Certified lead-free to NSF 61 / NSF 372 and suited to 180 degrees F.

B. Basis of design (bronze valves):

1. NIBCO T-585-66-LF (full port) for all sizes up through 2".
2. NIBCO T-580-66-LF (conventional port) for sizes 2-1/2" and 3".

C. Valves 4" and larger shall be split body stainless steel construction, 275 psi cold working pressure, blow-out proof stem, PTFE seated, type 316 stainless steel trimmed, class 150, full port design with manual gear operator. NIBCO F-515-S6-F-66-FS.

D. Acceptable alternate manufacturers:

1. Apollo 77 CLF-A series (full port) for all sizes up through 2".
2. Milwaukee UPBA-400S (full port) for all sizes up through 2".
3. Apollo 77 CLF-A series (full port) for size 2-1/2" and Apollo 70LF-140 series (standard port) for 3".
4. Milwaukee UPBA-100S (standard port) for sizes 2-1/2" and 3".

E. Applies to domestic water system installations.

F. Provide valves complete with extended lever handles as required to accommodate insulation and full valve operation.

G. Provide valves complete with memory stop kit where used for balancing applications.

2.9 BALANCING VALVES

A. Self-contained, fully automatic thermally actuated balancing valve shall continuously adjust flow to maintain the desired domestic hot water temperature within the branch line, regardless of system operating pressure. Valve shall modulate between open and closed position within a 10 degrees F range. The valve set-point (closing temperature) shall be the hot water system supply temperature. Valve body and all internal components shall be constructed of stainless steel with major components constructed of Type 303 stainless. Rated for 200 psi maximum working pressure and no less than 250 degrees F maximum working temperature. Lead-free NSF 372 and NSF 61 compliant. Threaded connections.

B. Basis of design:

1. ThermOmegaTech Circuit Solver, sizes 1/2" through 2”. Provide a union and ball type shutoff valve on both sides of the balancing valve.
2. ThermOmegaTech Circuit Solver with integrated union (CSU) assembly, sizes 1/2" and 3/4". Balancing valve assembly shall come complete with union body and ball type shutoff valves on both sides.
3. Provide complete with an integral check valve from the manufacturer, positioned after the balancing valve. For balancing valves not available with an integral check valve as part of the manufacturer's assembly, ensure to provide a lead-free swing type check valve on the downstream side of the balancing valve component.

C. Applies to circulated domestic hot water system installations including multi-branch parallel piping circuits and single-loop piping circuits.

1. Provide balancing valve at end of each domestic hot water supply line (after last fixture served) just prior to the hot water return line, as indicated on Drawings and in accordance with manufacturer’s installation recommendations.
2. Provide a pipe tee or elbow with bushing as appropriate, 3/4" threaded thermowell, and bi-metal adjustable angle 3 inch dial thermometer upstream of each balancing valve. Thermowell stem length and thermometer temperature probe length to be suited for pipe size, insulation thickness, and to ensure clearance for maintenance access and easy viewing of thermometer. Trerice bimetal/sensor, threaded-stepped shank thermowell (style 76) of lead-free brass (PBF) material. Trerice Model B836 thermometer with 300 stainless steel case and stem, hermetically sealed, double strength glass windowed, aluminum white-faced dial, complete with external reset and 0 to 200 degrees F range. Thermowell and thermometer face to be oriented upright for readability.

PART 3 - EXECUTION

3.1 EXCAVATION, BEDDING AND BACKFILL

A. This section shall apply for the excavation, bedding, and backfill of all buried piping unless specifically noted otherwise. All work shall be coordinated with any job site subsurface drainage/dewatering and adjusted accordingly.

B. Establish elevations of buried piping outside the building to ensure the following:

1. Not less than 2 feet of cover, or not less than maximum depth of frost penetration, whichever is the greater.
2. For water lines intended for fire protection service, the depth of cover shall be:

    a. Not less than 2’-6” in those locations where frost is not a factor.
    b. Not less than 1’-0” below the frost line for the locality.
    c. Not less than 3’-0” for piping under driveways.
    d. Not less than 1’-0” below the bottom of the building foundation/footers.
    e. In full compliance with the requirements of NFPA 13 and NFPA 24.

C. Excavation:

1. Excavate trenches for underground piping to the required depths.
2. The bottom of the trench or excavation shall be cut to a uniform grade.
3. Should rock be encountered, excavate 6 inches below grade, fill with bedding material and tamp to existing density.
4. Coordinate alignment of pipe trenches to avoid obstructions. Ensure that proposed routing of pipe will not interfere with building foundation before any trenching has begun. Should conflicts occur, contact Architect/Engineer before proceeding.
5. Should any sleeving of the building foundation be required, this shall be provided as directed by the structural engineer of record AND in accordance with the prevailing code, but in no case shall the sleeve be any less than two (2) pipe sizes greater than the pipe it serves.

D. Bedding and Backfill:

1. Backfill shall not be placed until the piping has been inspected, tested and approved. Complete backfill to the surface of natural ground or to the lines and grades indicated on drawings. Provide 6 inch stabilized sand bed with 4 inch stabilized sand cover around each pipe. Provide select fill up to finished surface or grade, unless indicated otherwise by project geotechnical report or specified otherwise in Division 02.
2. Compacting Backfill: Place material in uniform layers of 8 inches maximum, loose measure and compact to not less than 95% of maximum soil density as determined by ASTM D698 Standard Proctor.
3. 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.
4. A clay fill “trench plug” extending 3 feet inside the building line and 5 feet outside the building line shall be placed to completely surround utility lines passing beneath the foundation and grade beam. The materials shall consist of on-site soils with a plasticity index (PI) between 30 and 40 percent compacted to at least 95 percent of the Standard Proctor and maximum dry density as determined by ASTM D698.

E. Cement Stabilized Sand:

1. Materials:

   a. Cement shall be Type I Portland cement conforming to ASTM C150/C150M.
   b. Sand shall be clean, durable sand meeting grading requirements for fine aggregates of ASTM C33/C33M and free of organic matter and deleterious substances.
   c. Water shall be potable and free of oils, acids, alkalis, organic matter, or other deleterious substances, meeting requirements of ASTM C94/C94M.

2. Mixture:

   a. Product shall consist of not less than 1.5 sacks of Portland cement per ton of dry sand.
   b. Mixture shall contain sufficient water to hydrate the cement and be thoroughly mixed in a pugmill type mixer.

F. For water lines (including In-Building Risers) intended for fire protection service, provide joint restraints by way of concrete thrust blocks in accordance with the requirements of NFPA 13 and NFPA 24.

G. Aggressive Soil Conditions: Soil shall be considered aggressive and protection of buried metallic piping shall be provided as specified if any of the following situations exist:

1. Conditions are identified as such by the project geotechnical report or project geotechnical engineer.
2. The soil environment is a landfill area, swamp, marsh, polluted river bottom, cinder bed, or has alkaline soils.
3. A score of ten or higher is tallied when applying the soil assessment tool detailed in Appendix A of AWWA C105/A21.5. An excerpt of this evaluation procedure is provided below for reference but is not intended as a substitute for the complete and latest Standard:

NUMERICAL CORROSIVITY SCALE	
Soil Parameter	**Assigned Points**
Resistivity (ohm-cm)	
< 700	10
700 - 1,000	8
1,000 - 1,200	5
1,200 - 1,500	2
1,500 - 2,000	1
> 2,000	0
pH	
0 - 2	5
2 - 4	3
4 - 6.5	0
6.5 - 7.5	0
7.5 - 8.5	0
> 8.5	3
Redox Potential (mV)	
> 100	0
50 - 100	3.5
0 - 50	4
< 0	5
Sulfides	
Positive	3.5
Trace	2
Negative	0
Moisture	
Poor drainage continuously wet	2
Fair drainage generally moist	1

NUMERICAL CORROSIVITY SCALE	
Good drainage generally dry	0

H. Pipe Penetrations of Buried Exterior Walls or Foundations

1. Unless specifically indicated otherwise on the Drawings, each pipe penetration shall be provided with a schedule 40 steel pipe sleeve no less than two (2) pipe sizes larger than pipe itself.
2. At each penetration provide GPT Industries (“Thunderline”) Link Seal Modular Seal LS series. The exact model shall be as required for the pipe material, pipe size, and sleeve length for the penetration. Provide complete with EPDM sealing element and model “C” zinc coated carbon steel hardware.

3.2 INSTALLATION

A. General requirements for piping:

1. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
2. Remove any scale, oil and dirt, on inside and outside, before assembly.
3. Prepare piping connections to equipment with flanges or unions.
4. Confirm pipe placement, depth/elevation, and flow lines prior to any installation.

B. General requirements for valves:

1. Install valves with stems upright or horizontal, not inverted.
2. Valves shall be line-sized unless specifically noted otherwise.
3. Provide clearance for installation of insulation and access to valves and operable fittings. Valves installed beyond reasonable reach shall be provided with a chain operator.
4. Provide access doors where valves and operable fittings are not otherwise accessible. Access doors shall be of approved types set in locations pre-approved by submittal to the Architect.
5. Gate valves installed buried shall be covered with an adjustable cast iron roadway box extended to grade. Cover shall be cast iron with 'water' cast on top of cover and shall be set flush to finished paving or 2" above finished earthen grade. Box shall be supported from undisturbed soil or concrete base and shall not introduce any stress to piping under all traffic conditions.

C. Install all materials in accordance with the manufacturer's published instructions.

D. Unburied piping inside the building shall be installed concealed, out of public view wherever possible (above ceilings, inside walls and chases, within casework, etc.). This requirement shall not apply to fixture supplies & stops and chrome plated tubular brass drainage piping.

E. All exposed sewer and water pipe in toilet rooms or other finished areas of the building shall be chrome plated.

F. Provide non-conducting dielectric connections wherever joining dissimilar metals.

G. Route piping in an orderly manner, parallel and perpendicular to building column grid lines, unless indicated otherwise on drawings, and maintain gradients.

H. Install piping to conserve building space and not conflict with other trades or interfere with intended use of space.

I. Group piping whenever practical at common elevations.

J. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

K. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.

L. Provide encasement for and support for utility meters in accordance with the requirements of utility companies.

M. Prepare pipe, fittings, supports, and accessories not pre-finished, ready for finish painting.

N. Maintain uniformity in the installation of piping materials and joining methods. Do not mix material types.

O. Where connecting new underground sanitary, storm, or vent piping to existing piping of dissimilar material, provide suitable mechanical transition fittings complete with corrosion protection for metallic elements. Chase Construction Products Tapecoat H35 or approved equivalent and a final coat of coal tar to completely cover the transition.

P. Solder joints shall be wiped clean at each joint, remove excess metal while molten and flux residue when cooled.

Q. Waste nipple from wall to tapped tee shall be schedule 40 threaded galvanized steel pipe or brass or copper with threaded adapter.

R. General requirements for cast iron piping installation:

1. Install all pipe and fittings in accordance with published recommendations from the manufacturer and the Cast Iron Soil Pipe Institute (CISPI). Specific items referenced below are not intended as a substitute for the complete and latest recommendations.
2. Install bell and spigot type pipe with bell end upstream.
3. Above ground horizontal pipe (suspended) shall:

    a. Be supported at no less than at every joint, and within 18” of the hub or coupling.
    b. Be maintained in alignment. Sagging or grade reversal shall be unacceptable.
    c. Be supported at terminal ends of all runs or branches and at each change of direction or alignment.
    d. Have all closet bends, traps, trap arms, and similar branches firmly secured.
    e. Be braced to prevent movement or joint separation.
    f. Be provided with suitable sway bracing (such as clamps, rods, and hardware) where pipe and fittings are suspended in excess of 18” by means of non-rigid hangers.

4. Above ground vertical pipe shall:

    a. Be secured at each stack base.
    b. Be secured at each floor and riser clamps shall be provided on no greater than 15'-0" intervals.
    c. Be adequately supported to keep the system (pipe and contents) in alignment.

5. Provide seismic restraints in seismically active areas, whether specifically required by the prevailing code or not.

S. For all buried non-metallic piping outside the building, provide minimum 14 AWG solid copper tracer wire (ASTM B1, ASTM B3) with high molecular weight polyethylene insulation (HMWPE) per ASTM D1248. Wire shall be suited for direct bury applications to facilitate the detection and tracing of underground piping systems. THHN wire and other such nylon jacketing shall not be allowed. Insulation color shall be provided per the particular utility, in accordance with the American Public Works Association (APWA) uniform color code. Provide corrosion proof wire connectors with twist locking design and protective dielectric sealant. Copperhead Industries, LLC Snakebite or pre-approved equivalent. Tracer wire shall be placed in the same orientation as the installed pipe and laid six inches directly above the piping. One end of the tracer wire shall be brought aboveground at a building wall or riser for easy identification.

T. PVC pipe, fittings, or similar un-rated material shall not be installed in a return air plenum unless the entire length of all such piping is encased within a minimum two (2) hour fire rated enclosure.

U. Installations of buried thermoplastic piping systems shall be in strict conformity with the manufacturer's published instructions and the requirements of ASTM D2321 (gravity pipe) and ASTM D2774 (pressure pipe).

V. Installation of thermoplastic piping systems which are not buried shall be in accordance with the manufacturer's recommendations. The specific items indicated below are not intended as a substitute for the complete and latest manufacturer's recommendations.

1. Hangers and supports shall not compress, distort, cut, or abrade the piping. Nor shall they force the pipe and fittings into position.
2. Piping shall be supported at intervals sufficiently close to maintain pipe alignment and to prevent any sagging or grade reversal. System maximum operating temperature will determine support spacing.
3. Piping shall be supported at all branch ends and at all changes of direction, as close as practical to the fitting to avoid introducing excessive torsional stresses into the system.
4. Directly support (or if need be, immediately adjacent to) concentrated loads in the system, such as valves and other appurtenances.
5. Allowances must be made for thermal expansion and contraction of the piping system where temperature fluctuations can reasonably be expected to produce such movement. Provide and place hangers accordingly so as not to restrict.
6. Plastic piping systems shall not be placed alongside steam or other high temperature pipe lines or other high temperature objects.
7. Drainage piping shall be supported at trap arms as close as possible to the trap and all closet bends shall be supported and braced.

W. Installation of solvent cement joints for PVC and CPVC piping shall be in strict conformity with the requirements of ASTM D2855 and manufacturer's published instructions.

X. Provide approved heavy duty transition coupling at each transition from cast iron pipe not buried to buried PVC pipe as specified elsewhere in this section. Transition shall be made as close as possible to the floor for sanitary DWV piping systems and at test tee "minimum 12 inches A.F.F." for storm drainage piping. Support vertical cast iron pipe from floor anchors using riser clamp and galvanized all thread rod as specified in Section 220529.

Y. All grooved system tools and components (couplings, adapters, fittings, gaskets, and specialties) shall be the product of a single domestic system manufacturer.

Z. Grooved pipe system manufacturer shall provide on-site training for contractor's field personnel by a factory trained representative in the proper use of grooving tools, application of groove, and product installation. Factory trained representative shall periodically visit the job site and inspect installation. Contractor shall remove and replace any improperly installed products at no additional cost to the owner.

3.3 APPLICATION

A. Provide union downstream of all valves at equipment or apparatus connections.

B. Provide unions downstream of all threaded isolation valves in the domestic water system to facilitate any future valve replacement.

C. Provide male adapters each side of threaded valves in copper piped system. Sweat solder adapters to tube prior to make-up of threaded connections.

D. Provide approved isolation valves for shut-off and to isolate all equipment items and distinct parts of systems. Isolation valves shall be provided for both hot and cold water in locations including, but not necessarily limited to, the following:

1. At the domestic water service entry.
2. At each wing of the building.
3. At each floor for each domestic water tap branching off from a vertical riser.
4. At each domestic water branch line capped for future use.
5. At each restroom or restroom group.
6. At each hose bibb, wall hydrant, roof hydrant, hose reel, and trap primer device (except for flush valve or tailpiece type trap primer devices).
7. At each domestic water branch line within 24" of the corresponding main.
8. At each plumbing fixture not otherwise served by a localized fixture group isolation valve.
9. At each kitchen or similar food service space.

E. Each plumbing water rough-in stub out shall be fitted with a supply stop.

F. Valves installed in insulated piping shall be fitted with extended lever operators of sufficient length to raise handle above the insulation jacket material. Where valve is used for throttling service, the valve handle shall be equipped with adjustable memory stop device.

G. Provide non-slam type check valves on discharge lines from all water pumps. Install at a minimum length of 5 times the pipe diameter from the pump and in accordance with manufacturer's installation recommendations.

3.4 ERECTION TOLERANCES

A. All gravity drainage piping shall be provided at a uniform and continuous slope in accordance with the prevailing plumbing code and as described below. If any of the criteria below conflicts with the prevailing code, then the code requirements shall govern:

1. Gravity piping 3" and smaller shall be provided at no less than 1/4" per foot slope.
2. Gravity piping 4" and larger shall be provided at no less than 1/8" per foot slope.
3. Where the code allows for a shallower slope than indicated above, this shall be allowed if required per project conditions.
4. Where the code requires a steeper slope than indicated above (such as for grease waste piping) than such requirements shall control.

B. All vent and branch vent pipes shall be graded and connected as to drip back by gravity to the drainage pipe it serves. A slope of 1 inch per 40 feet will suffice for this requirement, subject to the approval of the local Authority Having Jurisdiction.

C. Slope all horizontal water piping with uniform pitch of 1/8 inch per 10 feet to low points to allow for complete system drainage. For long runs, where constant pitch cannot be maintained, provide intermediate low points and rise up again from such locations. Slope horizontal branches back to mains or risers. Provide clearly identified supplementary drain valves where hose bibbs, hydrants, or sill cocks will not suffice for this requirement.

3.5 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

A. Prior to starting work, all domestic water systems shall be complete, thoroughly flushed clean and free of all foreign matter or erection residue.

B. Ensure PH of water to be treated is between 7.4 and 7.6 by adding alkali (caustic soda or soda ash) or acid (hydrochloric).

C. On building side of the main shut off valve, provide a 3/4" connection through which chlorine can be introduced into the water piping

D. Inject disinfectant, free chlorine in liquid, powder, tablet or gas form, in sufficient quantity to obtain 50 to 80 mg/L residual free chlorine solution throughout the entire domestic water piping systems.

E. Bleed water from outlets as required to ensure complete distribution and test for disinfectant residual at a minimum 15 percent of total outlets.

F. Maintain disinfectant in system for 24 hours.

G. If final disinfectant residual tests less than 25 mg/L, repeat treatment.

H. Flush disinfectant from system until residual equal to that of incoming water or 1.0 mg/L.

I. Take samples no sooner than 24 hours after flushing, from 5 percent of outlets and from water entry, and analyze in accordance with AWWA C651.

3.6 SERVICE CONNECTIONS

A. Provide new sanitary and storm sewer services connecting to existing building services or utility lines as shown on the drawings.

B. Before commencing work, field verify invert elevations required for sewer connections, confirm inverts and ensure that these can be properly connected with slope for drainage and cover as required.

C. Provide new domestic water service connecting to existing building services or utility lines as shown on plans. Assure connections are in compliance with requirements of the jurisdiction having authority.

D. Extension of services to the building shall be fabricated from the same materials as the utility service lines or those materials specified herein.

E. Should points of connection vary from those indicated on the drawings contractor shall properly allow for this in the actual connections field fabricated.

3.7 RODDING SEWERS

A. All sanitary soil and waste lines, both in the building and out, shall be rodded out after completion of the installation.

B. This Work shall be done, as part of the contract, to make certain that all lines are clear, and any obstruction that may be discovered shall be removed immediately. Rodding shall be accomplished by utilizing a rotary cutter, which shall be full size of pipe being cleaned.

3.8 VIDEO INSPECTION AND DOCUMENTATION

A. It shall be the responsibility of the plumbing contractor to retain the services of a qualified, independent company (other than the installing plumbing contractor) with no less than ten (10) years of experience in digital video camera inspection/investigation of plumbing drainage waste and vent lines for commercial/institutional building projects.

B. The independent company shall perform a complete video camera inspection of all waste piping buried inside the building. This shall include sanitary waste and any specialty waste (grease waste, oily waste, etc.) systems and shall extend from the building all the way to any associated outdoor traps/interceptors.

C. The independent company shall create a permanent digital video record of their inspection with accompanying definitive identification (audio or visual) to indicate different systems and different areas of the systems inspected.

D. The independent company shall prepare a comprehensive written report including, but not necessarily limited to, the following:

1. Complete company contact information.
2. Project name and address.
3. Date(s), time(s), and conditions during the inspection(s).
4. Name(s) of the operator(s) performing the inspection(s).
5. A general summary of the inspection results.
6. A written description of any and all material and/or installation deficiencies or irregularities found, with accompanying pictorial documentation. This shall include conditions such as:

    a. Deformed or damaged piping
    b. Full or partial blockage of piping
    c. Deleterious material or debris within the piping
    d. Slope deficiencies (inadequate, inconsistent, or absent slope)
    e. Valleys or “dips” in the piping
    f. Improper fittings in the piping including reductions in pipe size in the direction of flow

E. The written report shall be submitted under this Section but separately from other submittals of this Section. This shall occur immediately prior to substantial completion.

F. The written report and the digital video record (DVD or USB flash drive) shall also be submitted as part of the Project Record Documents.

3.9 TESTING OF PLUMBING PIPING SYSTEMS

A. During the progress of the work and upon completion, tests shall be made as specified herein and as required by Authorities Having Jurisdiction, including Inspectors, Owner or Architect. The Architect or duly authorized Construction Inspector shall be notified in writing at least 2 working days prior to each test or other Specification requirement which requires action on the part of the Construction Inspector.

B. Tests shall be conducted as part of this work and shall include all necessary instruments, equipment, apparatus, and service as required to perform the tests with qualified personnel. Submit proposed test procedures, recording forms, and test equipment for approval prior to the execution of testing.

C. Tests shall be performed before piping of various systems have been covered or furred-in. For insulated piping systems testing shall be accomplished prior to the application of insulation.

D. All piping systems shall be tested and proved absolutely tight for a period of not less than 24 hours. Tests shall be witnessed by the Architect or an authorized representative and pronounced satisfactory before pressure is removed or any water drawn off.

E. Leaks, damage or defects discovered or resulting from test shall be repaired or replaced to a like new condition. Leaking pipe joints, or defective pipe, shall be removed and replaced with acceptable materials. Test shall be repeated after repairs are completed and shall continue until such time as the entire test period expires without the discovery of any leaks.

F. Wherever conditions permit, each piping system shall thereafter be subjected to its normal operating pressure and temperature for a period of no less than five 5 days. During that period, it shall be kept under the most careful observation. The piping systems must demonstrate the propriety of their installation by remaining absolutely tight during this period.

G. Domestic Water: Pressure test at one- and one-half times the normal working pressure or 125 psig, whichever is the greater, for 24 hours.

H. Sanitary Soil, Waste and Vents and Storm Sewer:

1. After the rough-in soil, waste and vent and other parts of the sanitary sewer including branch laterals have been set from the lowest level, at point of connection to existing utility lines, to above the floor line, all outlets shall be temporarily plugged or capped, except as are required for testing as described herein. Ground work shall not permit the backfill of trenches to cover any joints until the completion of testing. Back fill shall be limited to mid sections of full joints of piping only. For pipe in ground the piping shall be readied as described herein and filled with water to a verifiable and visible level to 10' above the lowest portions of the system being tested.
2. On multi-level buildings only one floor level shall be tested at a time. Each floor shall be tested from a level below the structure of the floor, or the outlet of the building in the case of the lowest level, to a level of 12 inches above the floor immediately above the floor being tested, or the top of the highest vent in the case of the highest building level. The pipes for the level being tested shall be filled with water to a verifiable and visible level as described above and be allowed to remain so for 24 hours. If after 24 hours the level of the water has been lowered by leakage, the leaks must be found and stopped, and the water level shall again be raised to the level described, and the test repeated until, after a 24 hour retention period, there shall be no perceptible lowering of the water level in the system being tested.
3. Should the completion of these tests leave any reasonable question or doubt of the integrity of the installation, additional tests including peppermint smoke, or other measures shall be performed to demonstrate the reliability of these systems to the complete satisfaction of the Owner's duly authorized representative. Such tests shall be conducted and completed before any joints in plumbing are concealed or made inaccessible.

3.10 COMPLETE FUNCTIONING OF WORK

A. All work reasonably implied as essential to the complete functioning of the systems shown on the Drawings and Specification shall be completed as part of the work of this Division, unless specifically stated otherwise. It is the intention of the Drawings and Specification to establish the type and function of systems but not to set forth each item essential to the functioning of any system. In case of doubt as to the work intended or in the event of amplification or clarification thereof, the Contractor shall call upon the Architect for Supplementary Instructions and Drawings, etc.

END OF SECTION 221000

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SECTION 221119 - PLUMBING SPECIALTIES

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

B. The Basic Materials and Methods, Section 220200, are included as a part of this Section as though written in full in this document.

1.2 SCOPE

A. The scope of the work shall include the furnishing and complete installation of the specialties covered by this Section, with all appurtenances, ready for the Owner’s use.

B. Include the following work in addition to items normally part of this Section:

1. Hose Bibbs and Hydrants
2. Backflow Preventers
3. Water Hammer Arresters
4. Strainers and Filters
5. Thermostatic Mixing Valves
6. Floor Drains and Floor Sinks
7. Cleanouts
8. Trap Primers
9. Roof Drains and Overflow Nozzles

1.3 RELATED WORK

A. Section 220529 - Hangers and Support for Plumbing Piping and Equipment

B. Section 221000 - Plumbing Piping

C. Section 223000 - Plumbing Equipment

D. Section 224000 - Plumbing Fixtures

1.4 REFERENCES

A. ASME A112.6.3 - Floor Drains; 2022.

B. ASME A112.6.4 - Roof, Deck, and Balcony Drains; 2022.

C. ASME A112.14.1 - Backwater Valves; 2008.

D. ASME A112.1070 - Performance requirements for water temperature limiting devices; 2020.

E. ASSE 1010 - Performance Requirements for Water Hammer Arresters; 2004.

F. ASSE 1011 - Performance Requirements for Hose Connection Vacuum Breakers; 2023.

G. ASSE 1012 - Performance Requirements for Backflow Preventers with an Intermediate Atmospheric Vent; 2021.

H. ASSE 1013 - Performance Requirements for Reduced Pressure Principle Backflow Prevention Assemblies; 2021.

I. ASSE 1015 - Performance Requirements for Double Check Backflow Prevention Assemblies; 2021.

J. ASSE 1019 - Performance Requirements for Wall Hydrant with Backflow Protection and Freeze Resistance; 2023.

K. ASSE 1060 - Performance Requirements for Outdoor Enclosures for Fluid Conveying Components; 2017 (Reaffirmed 2021).

L. ASSE 1069 - Performance Requirements for Automatic Temperature Control Mixing Valves; 2020.

M. ASSE 1070 - Performance Requirements for Water Temperature Limiting Devices; 2020.

N. ASSE 1071 - Performance Requirements for Temperature Actuated Mixing Valves for Plumbed Emergency Equipment; 2012.

O. NSF 372 - Drinking Water System Components - Lead Content; 2022.

P. PDI-WH 201 - Water Hammer Arresters; 2017.

Q. ASME A112.6.7 - Sanitary Floor Sinks

R. ASSE 1057 - Performance Requirements for Freeze Resistant Sanitary Yard Hydrants with Backflow Protection

S. ASSE 1069 - Performance Requirements for Automatic Temperature Control Mixing Valves

T. AWWA C510 - Standard for Double Check Valve Backflow Prevention Assembly

U. NSF 61 - Drinking Water System Components - Health Effects

1.5 QUALITY ASSURANCE

A. Manufacturer: For each product specified, provide components by the same manufacturer throughout.

1.6 SUBMITTALS

A. Submit under provisions of Division One.

B. Submit shop drawings and product data under provisions of Division One.

C. Include component sizes, rough-in requirements, service sizes, and finishes.

D. Manufacturer's Installation Instructions: Indicate assembly and support requirements.

1.7 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Division One.

B. Record actual locations of equipment and backflow preventers.

1.8 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Division One.

B. Operation Data: Indicate frequency of treatment required for interceptors and separators.

C. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

1.9 DELIVERY, STORAGE, AND HANDLING

A. DELIVERY: Deliver clearly labeled specialties to; and store, protect and handle products on site in accordance with the provisions of Division One.

B. TIMING AND COORDINATION: Arrange for delivery of materials to allow for minimum storage time at the project site. Coordinate with the scheduled time of installation.

C. ACCEPTANCE: Accept specialties on site in original factory packaging. Inspect for damage. Damaged specialties shall not be acceptable.

D. STORAGE: Store materials in a clean, dry location, protected from weather and damage.

1.10 EXTRA MATERIALS

A. Furnish under provisions of Division One.

B. Provide two loose keys for hose bibbs and hydrants and spare hose end vacuum breakers.

1.11 OPERATIONS PERSONNEL TRAINING

A. Provide a training session for the owner's operations personnel. Training session shall be performed by a qualified person who is knowledgeable in the subject system/equipment. Submit a training agenda two weeks prior to the proposed training session for review and approval. Training session shall include at the minimum:

1. Purpose of equipment.
2. Principle of how the equipment works.
3. Important parts and assemblies.
4. How the equipment achieves its purpose and necessary operating conditions.
5. Most likely failure modes, causes, and corrections.
6. On site demonstration.

1.12 REGULATORY REQUIREMENTS

A. Conform to applicable codes for the provision and installation of all required backflow prevention devices.

B. Provide certificate of compliance from authority having jurisdiction indicating approval of installation of backflow prevention devices.

C. Provide backflow prevention assembly test and maintenance report for all devices. A printed and signed form by the licensed tester that performed the work shall be provided both to the Owner and to the Public Water System in accordance with TCEQ (Texas Commission on Environmental Quality) requirements.

PART 2 - PRODUCTS

2.1 HOSE BIBBS/HYDRANTS

A. General: Provide an operating handle for each loose keyed device on the project.

B. Hose Bibb: Bronze or brass construction, replaceable stem assembly, hose thread spout, complete with vandal resistant lockshield and ASSE 1011 integral vacuum breaker. Provide chrome plated and with removable key where exposed in public areas.

C. Wall Hydrant: Bronze or brass construction, replaceable stem assembly, hose thread spout, non-freeze, self-draining type with integral vacuum breaker. ASSE 1019. Unless specifically noted otherwise, provide recessed complete with heavy cast aluminum or nickel plated brass lockable box and loose key operator.

D. ACCEPTABLE MANUFACTURERS:

1. J.R. Smith
2. Zurn
3. Mifab

4. Watts
5. Wade
6. Chicago (interior use hose bibbs only)
7. Woodford
8. Prier

2.2 RECESSED VALVE BOX

A. Washing Machine: Pre-formed galvanized or stainless steel rough-in box with brass long shank valves with wheel handles, threaded drain fitting for waste, and matching secured faceplate. PVC constructed box, faceplate, and bracket will be acceptable within dwelling units only, in residential occupancies only.

B. Refrigerator: Pre-formed galvanized or stainless steel rough-in box with brass long shank valve with wheel or quarter-turn handle and matching secured faceplate. PVC constructed box, faceplate, and bracket will be acceptable within dwelling units only, in residential occupancies only.

C. ACCEPTABLE MANUFACTURERS:

1. Guy Gray
2. Mifab
3. Sioux Chief
4. Oatey

2.3 BACKFLOW PREVENTERS

A. General Requirements: All assemblies shall be suited for the system anticipated working pressure and temperature as well as the intended orientation (vertical or horizontal) of the installation. All assemblies shall be lead-free per NSF 372, unless specifically noted otherwise on the Drawings.

B. Strainer Requirements: Lead-free compliant strainers shall be provided at all backflow preventers on the upstream side of each assembly. Strainer bodies shall be either bronze/cast copper alloy or of cast iron/ductile iron construction with an FDA approved epoxy coating. Screens and internal components shall be stainless steel.

C. Reduced Pressure Backflow Preventers: ASSE 1013; Bronze or FDA approved epoxy coated cast iron body with corrosion resistant internal parts and stainless steel springs; two independently operating, spring loaded check valves; intermediate internal pressure intermediate relief valve with water outlet; test cocks and isolation valves.

D. Double Check Valve Assemblies: ASSE 1015; Cast copper alloy or FDA approved epoxy coated cast iron body with corrosion resistant internal parts and stainless steel springs; two independently operating check valves, test cocks and isolation valves.

E. Dual Check Valve with Intermediate Atmospheric Vent: ASSE 1012; Brass body with corrosion resistant internal parts and stainless steel springs; two independently operating check valves with intermediate atmospheric vent.

F. ACCEPTABLE MANUFACTURERS:

1. Watts
2. Wilkins
3. Febco
4. Beeco
5. Apollo

2.4 WATER HAMMER ARRESTERS

A. Engineered water hammer arresters: ASSE 1010 listed, lead-free, pre-charged, permanently sealed, maintenance- free, suited for concealed installation, with a working temperature range of 33 to no less than 212 degrees F and a maximum working pressure of no less than 250 psi during pressure surges. Stainless steel or copper body construction. Shall be sized and located in accordance with Plumbing Drainage Institute standard PDI-WH 201.

B. ACCEPTABLE MANUFACTURERS:

1. J.R. Smith
2. Zurn
3. Mifab
4. Wade
5. P.P.P.

2.5 THERMOSTATIC MIXING VALVES

A. Provide thermostatic mixing valves in accordance with manufacturer’s recommendations and as indicated and scheduled on Drawings.

1. Unless scheduled otherwise, all units other than under-counter point of use units shall be provided complete in lockable cabinet of 16 gage (1.5 mm) prime coated steel when located in finished areas.
2. All under-counter point of use units shall be provided complete with integral checks and dual stainless steel strainers on inlets for protection against fouling.

B. Types and Requirements:

1. Where hot and cold water is supplied to emergency safety fixtures, the temperature shall be controlled by a temperature actuated mixing valve complying with ASSE 1071.
2. Valves for individual showers are addressed in Section 224000 - Plumbing Fixtures
3. (Master) mixing valves serving multiple showers, each with a single tempered water supply pipe, shall conform to ASSE 1069 or CSA B125.3. Such valves shall be provided complete with unions, checks, and ball valves at all connections as well as a temperature gauge on the outgoing water line.

4. Mixing valves serving (athletic area) whirlpool applications shall conform to ASSE 1070 / ASME A112.1070 / CSA B125.70 or CSA B125.3. Such valves shall also be configured with appurtenances as described above.
5. Mixing valves supplying tempered water to lavatories and sinks shall conform to ASSE 1070 / ASME A112.1070 / CSA B125.70 or CSA B125.3.

C. ACCEPTABLE MANUFACTURERS:

1. Powers
2. Symmons
3. Lawler

2.6 FLOOR DRAINS AND FLOOR SINKS

A. Provide floor drains and floor sinks in accordance with manufacturer's recommendations, as appropriate for floor construction per ASME A112.6.3, and as indicated and scheduled on Drawings.

B. Provide clamping devices for all drains in membrane floor areas.

C. ACCEPTABLE MANUFACTURERS:

1. J.R. Smith
2. Zurn
3. Mifab
4. Wade
5. Josam

D. Provide drains of suitable and compatible material for specialized piping systems conveying acid waste.

2.7 CLEANOUTS

A. General: Provide cleanouts as indicated and scheduled on Drawings and also as required by the prevailing code, whether shown on the Drawings or not.

B. Construction: All cleanouts shall have tapered PVC, ABS, or polypropylene plugs.

C. Provide clamping devices for all cleanouts in membrane floor areas.

D. Provide cleanouts of suitable and compatible material for specialized piping systems conveying acid waste.

E. Types:

1. Finished floor cleanouts: Provide cast iron body, with adjustable floor level assembly, and round nickel bronze scoriated top.

2. Resilient or tile finished floor cleanouts: Provide cast iron body, with adjustable floor level assembly, and round nickel-bronze top with gasketed water tight cover and depressed top to receive flooring finish material.
3. Interior finished wall cleanouts: Provide cast iron tee body or cleanout ferrule as required for wall construction and provide counter-sunk plug with stainless steel access cover and securing screw(s).
4. Interior unfinished accessible cleanouts: Calked or threaded type. Provide bolted stack cleanouts on vertical rainwater leaders.

F. ACCEPTABLE MANUFACTURERS:

1. J.R. Smith
2. Zurn
3. Wade
4. Josam

2.8 TRAP PRIMERS

A. General: Provide trap primers as indicated and scheduled on Drawings and in accordance with manufacturer's recommendations.

B. ACCEPTABLE MANUFACTURERS:

1. J.R. Smith
2. Zurn
3. Mifab
4. Watts
5. Wade
6. P.P.P.

2.9 BACKWATER VALVES

A. ASME A112.14.1; Lacquered cast iron body and cover, brass valve, access cover, extension sleeve as required and cover at finished elevation.

B. ACCEPTABLE MANUFACTURERS:

1. J.R. Smith
2. Zurn
3. Mifab
4. Watts
5. Wade

2.10 ROOF DRAINS AND OVERFLOW NOZZLES

A. Roof drains (RD): ASME A112.6.4; Lacquered cast iron body with sump, removable aluminum dome strainer, membrane flange and clamp with integral gravel stop, adjustable underdeck

clamp, roof sump receiver, waterproofing anchor flange, adjustable extension as required for insulation, perforated or slotted ballast guard extension for inverted roof.

B. Roof overflow drains (OD): Lacquered cast iron body and features similar to roof drain, with 2 inch external water dam or pipe extended to 2 inches above flood elevation.

C. ACCEPTABLE MANUFACTURERS:

1. J.R. Smith
2. Zurn
3. Watts
4. Wade
5. Josam

PART 3 - EXECUTION

3.1 INSTALLATION AND APPLICATION

A. Install specialties in accordance with manufacturer's instructions to provide intended performance.

B. Install equipment specific drains appropriately located to serve the equipment. Drain placement shall not conflict with housekeeping pads, casework, equipment access, clear space for foot travel, etc. In kitchens and similar settings final drain locations must be carefully coordinated to ensure that equipment casters, table legs, etc. do not bear upon drain grates.

C. Water hammer arresters:

1. The contractor shall provide water hammer arresters as shown on Drawings and also in accordance with PDI-WH 201, whether shown on Drawings or not.
2. Water hammer arresters shall be PDI certified and sized and placed as recommended by manufacturer.
3. Provide above lay-in ceiling, within chase or wall or above solid ceiling complete with access panel, or otherwise accessible location complete with isolation valve to facilitate replacement.
4. Provide for both domestic hot and cold water services.
5. The provision of air chambers for the control of water hammer shall not be acceptable, but for within dwelling units only, in residential occupancies only.

D. Backflow preventers:

1. Provide strainers at all backflow preventers.
2. Contractor shall certify all newly installed backflow preventers and provide proof of certification to the Owner.
3. Pipe relief line from backflow preventer via manufacturer’s air gap assembly, full size to nearest suitable drain. Such routing shall not pose a trip hazard. Where a suitable drain of appropriate size is not provided, route line to the outdoors.

4. All backflow preventers shall be securely supported with wall supports and/or pipe stands as appropriate for the size and weight of the unit and shall be installed with sufficient access and clearance for testing and maintenance. Unless specifically noted otherwise on Drawings, all backflow preventers shall be installed at 48”-60” above finished floor.
5. Unless specifically noted otherwise on the Drawings, outdoor installations shall be housed within an appropriately sized, ASSE 1060 Class I freeze and vandal protective insulated, marine grade aluminum constructed enclosure complete with drain panel and removable/movable panel(s) for device maintenance and testing. Provide complete with manufacturer's recommended electric heater. Safe-T-Cover by Hydrocowl.

E. Cleanouts:

1. Provide two-way cleanouts at all waste outfalls from the building.
2. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Ensure clearance at all cleanouts for access and for rodding of drainage system.
3. Wall cleanouts provided at the end of horizontal piping runs shall be installed vertically above the flow line of the pipe served.
4. All cleanouts outside of building not in paved areas, shall be set in an 18" x 18" x 4" thick concrete pad, flush with final grade.
5. All cleanouts shall be the same nominal size as the pipe they serve, up to 4 inches. For pipes larger than 4 inches, provide a 4 inch cleanout.

F. Trap primers:

1. In unfinished areas such as mechanical rooms, such devices may be installed exposed.
2. In finished areas, all devices must be installed concealed from public view. If not readily accessible (such as above a lay-in ceiling) ensure to provide an access door.

END OF SECTION 221119

SECTION 221313 - FACILITY SANITARY SEWERS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes gravity-flow, outside the building, with the following components:

1. Cleanouts
2. Manholes

B. All public work to be performed and materials to be used within the street right-of-way, shall be in accordance with the City of Austin Design Standards.

C. All private work to be performed and materials to be used beyond the street right-of-way shall be in accordance with the Plumbing Code. In the event of a discrepancy between the above-referenced standards, the plans, and/or any portion of this specification section, the order of precedence will be the plans, the City Design Standards, and then these specifications. The Contractor shall contact the engineer in the event of a discrepancy.

1.2 DEFINITIONS

A. PVC: Polyvinyl chloride plastic.

1.3 PERFORMANCE REQUIREMENTS

A. Gravity-Flow, Nonpressure, Drainage-Piping Pressure Rating: 10-foot head of water (30 kPa).

1.4 SUBMITTALS

A. Product Data: For the following:

1. Special pipe fittings.

B. Shop Drawings: For the following:

1. Manholes: Include plans, elevations, sections, details, and frames and covers.

C. Coordination Drawings: Show pipe sizes, locations, and elevations. Show other piping in same trench and clearances from sewerage system piping. Indicate interface and spatial relationship between manholes, piping, and proximate structures.

D. Field quality-control test reports.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Do not store plastic manholes, pipe, and fittings in direct sunlight.

B. Protect pipe, pipe fittings, and seals from dirt and damage.

C. Handle manholes according to manufacturer's written rigging instructions.

1.6 PROJECT CONDITIONS

A. Interruption of Existing Sanitary Sewerage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:

1. Notify Construction Manager no fewer than two days in advance of proposed interruption of service.
2. Do not proceed with interruption of service without Construction Manager's written permission.

PART 2 - PRODUCTS

2.1 PVC PIPE AND FITTINGS

A. PVC Pressure Pipe: AWWA C900, Class 150, for gasketed joints and using ASTM F 477, elastomeric seals.

1. Fittings NPS 4 to NPS 8 (DN 100 to DN 200): PVC pressure fittings complying with AWWA C907, for gasketed joints and using ASTM F 477, elastomeric seals.
2. Fittings NPS 10 (DN 250) and Larger: Ductile-iron, compact fittings complying with AWWA C153, for push-on joints and using AWWA C111, rubber gaskets.

B. PVC Sewer Pipe and Fittings, NPS 16 and Smaller: ASTM D 3034, SDR 26, with bell-and-spigot ends for gasketed joints with ASTM F 477, elastomeric seals.

2.2 NONPRESSURE-TYPE PIPE COUPLINGS

A. Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition coupling, for joining underground nonpressure piping. Include ends of same sizes as piping to be joined and corrosion-resistant-metal tension band and tightening mechanism on each end.

B. Sleeve Materials:

1. For Concrete Pipes: ASTM C 443 (ASTM C 443M), rubber.
2. For Cast-Iron Soil Pipes: ASTM C 564, rubber.
3. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
4. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

2.3 MANHOLES

A. Precast Concrete Manholes: ASTM C 478, precast, reinforces concrete, of depth indicated, with provision for rubber gasketed joints, and pipe boots.

1. Inside diameter: 48 inches minimum, unless otherwise indicated.
2. Base section: 8 inches minimum thickness for floor slab and 5-inch minimum thickness for walls and base riser section and having separate base slab or base section with integral floor.
3. Riser sections: 5-inch minimum thickness.
4. Top Section: Eccentric-cone type, unless otherwise indicated.
5. Gaskets: ASTM C 443, rubber (when required by local authority having jurisdiction).
6. Pipe connectors: ASTM C 923, resilient, of size required, for each pipe connecting to base section.
7. Joints of the manhole sections shall be of the tongue and groove type, filled with an approved preformed butyl rubber base, sealing compound, conforming to Federal Specifications SS-S210A, Type 1, Rope form.

B. Standard manhole frames and covers: shall conform to the standard detail of the regulatory authorities having jurisdiction for the project (if applicable). Otherwise, manhole frames and covers to be Neenah Foundary Co. No. R-1642 or Vulcan Foundary Inc. No. V-1357, 30” opening.

C. All sanitary sewer manhole covers shall have the word “SANITARY SEWER” cast on the top in letters 2 inches high.

2.4 CLEANOUTS

A. Gray-Iron Cleanouts: ASME A112.36.2M, round, gray-iron housing with clamping device and round, secured, scoriated, gray-iron cover. Include gray-iron ferrule with inside calk or spigot connection and countersunk, tapered-thread, brass closure plug, with a 2’ x 2’ x 6” thick concrete apron.

1. Available Manufacturers:

   a. Refer to City of Austin Utility Standards, latest edition.

2. Top-Loading Classification: Extra-heavy duty.
3. Sewer Pipe Fitting and Riser to Cleanout: ASTM A 74, Service class, cast-iron soil pipe and fittings.

2.5 CONCRETE

A. General: Cast-in-place concrete according to ACI 318/318R, ACI 350R, and the following:

1. Cement: ASTM C 150, Type II.
2. Fine Aggregate: ASTM C 33, sand.
3. Coarse Aggregate: ASTM C 33, crushed gravel.

4. Water: Potable.

B. Portland Cement Design Mix: 4000 psi (27.6 MPa) minimum, with 0.45 maximum water/cementitious materials ratio.

1. Reinforcement Fabric: ASTM A 185, steel, welded wire fabric, plain.
2. Reinforcement Bars: ASTM A 615/A 615M, Grade 60 (420 MPa), deformed steel.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavating, trenching, and backfilling are specified in Division 31 Section "Earth Moving."

3.2 PIPING APPLICATIONS

A. Pipe couplings and special pipe fittings with pressure ratings at least equal to piping rating may be used in applications below, unless otherwise indicated.

1. Use nonpressure-type flexible couplings where required to join gravity-flow, nonpressure sewer piping, unless otherwise indicated.

a. Unshielded flexible couplings for same or minor difference OD pipes.
b. Unshielded, increaser/reducer-pattern, flexible couplings for pipes with different OD.
c. Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.

2. Use pressure-type pipe couplings for force-main joints.

B. Special Pipe Fittings: Use for pipe expansion and deflection. Pipe couplings and special pipe fittings with pressure ratings at least equal to piping rating may be used in applications below, unless otherwise indicated.

C. Gravity-Flow, Nonpressure Sewer Piping:

1. NPS 3 (DN 80): NPS 4 (DN 100) PVC sewer pipe and fittings, gaskets, and gasketed joints.
2. NPS 4 (DN 100): PVC sewer pipe and fittings, gaskets, and gasketed joints.
3. NPS 5 and NPS 6 (DN 125 and DN 150): NPS 6 (DN 150) PVC sewer pipe and fittings, gaskets, and gasketed joints.

3.3 PIPING INSTALLATION

A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground sanitary sewerage piping. Location and arrangement of piping layout

take design considerations into account. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.

B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for using lubricants, cements, and other installation requirements.

C. Install manholes for changes in direction, unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.

D. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.

E. Tunneling: Install pipe under streets or other obstructions that cannot be disturbed by tunneling, jacking, or combination of both.

F. Install gravity-flow, nonpressure, drainage piping according to the following:

1. Install piping pitched down in direction of flow, at minimum slope of 1 percent, unless otherwise indicated.
2. Install piping NPS 6 (DN 150) and larger with restrained joints at tee fittings and at changes in direction. Use corrosion-resistant rods, pipe or fitting manufacturer's proprietary restraint system, or cast-in-place-concrete supports or anchors.
3. Install piping with 36-inch (915-mm) minimum cover.
4. Install piping below frost line.
5. Install hub-and-spigot, cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook."
6. Install hubless cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook."

3.4 PIPE JOINT CONSTRUCTION

A. Basic piping joint construction is specified in Division 22 Section "Common Work Results for Plumbing" Where specific joint construction is not indicated, follow piping manufacturer's written instructions.

B. Join gravity-flow, nonpressure, drainage piping according to the following:

1. Join PVC profile gravity sewer piping according to ASTM D 2321 for elastomeric-seal joints or ASTM F 794 for gasketed joints.
2. Join dissimilar pipe materials with nonpressure-type, flexible [or rigid] couplings.

3.5 MANHOLE INSTALLATION

A. General: Install manholes complete with appurtenances and accessories indicated.

B. Install precast concrete manhole sections with sealants according to ASTM C 923.

C. Construct cast-in-place manholes as indicated.

D. Install PE sheeting on earth where cast-in-place-concrete manholes are to be built.

E. Install FRP manholes according to manufacturer's written instructions.

F. Form continuous concrete channels and benches between inlets and outlet.

G. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops 3 inches (76 mm) above finished surface elsewhere, unless otherwise indicated.

H. Install manhole cover inserts in frame and immediately below cover.

3.6 CONCRETE PLACEMENT

A. Place cast-in-place concrete according to ACI 318/318R.

3.7 CLEANOUT INSTALLATION

A. Install cleanouts and riser extensions from sewer pipes to cleanouts at grade. Use cast-iron soil pipe fittings in sewer pipes at branches for cleanouts and cast-iron soil pipe for riser extensions to cleanouts. Install piping so cleanouts open in direction of flow in sewer pipe.

1. Use heavy-duty, top-loading classification cleanouts in vehicle-traffic service areas.
2. Use extra-heavy-duty, top-loading classification cleanouts in roads.

B. Set cleanout frames and covers in earth in cast-in-place-concrete block, 24” by 24” by 6” deep. Set with tops 1 inch (25 mm) above surrounding grade.

C. Set cleanout frames and covers in concrete pavement with tops flush with pavement surface.

3.8 CONNECTIONS

A. Connect nonpressure, gravity-flow drainage piping to building's sanitary building drains specified in Division 22 Section "Sanitary Waste and Vent Piping."

B. Make connections to existing piping and underground manholes.

1. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe; install wye fitting into existing piping; and encase entire wye fitting, plus 6-inch (150-mm) overlap, with not less than 6 inches (150 mm) of concrete with 28-day compressive strength of 3000 psi (20.7 MPa).
2. Make branch connections from side into existing piping, NPS 4 to NPS 20 (DN 100 to DN 500). Remove section of existing pipe; install wye fitting into existing piping; and encase entire wye with not less than 6 inches (150 mm) of concrete with 28-day compressive strength of 3000 psi (20.7 MPa).
3. Make branch connections from side into existing piping, NPS 21 (DN 525) or larger, or to underground manholes by cutting opening into existing unit large enough to allow 3 inches

(76 mm) of concrete to be packed around entering connection. Cut end of connection pipe passing through pipe or structure wall to conform to shape of and be flush with inside wall, unless otherwise indicated. On outside of pipe or manhole wall, encase entering connection in 6 inches (150 mm) of concrete for minimum length of 12 inches (300 mm) to provide additional support of collar from connection to undisturbed ground.

a. Use concrete that will attain minimum 28-day compressive strength of 3000 psi (20.7 MPa), unless otherwise indicated.
b. Use epoxy-bonding compound as interface between new and existing concrete and piping materials.

4. Protect existing piping and manholes to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.

C. Connect to grease interceptors specified in Division 22 Section "Sanitary Waste Interceptors."

3.9 FIELD QUALITY CONTROL

A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches (600 mm) of backfill is in place, and again at completion of Project.

1. Submit separate report for each system inspection.
2. Defects requiring correction include the following:

a. Alignment: Less than full diameter of inside of pipe is visible between structures.
b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter. Hand pulled no earlier than 30 days after backfill was completed.
c. Crushed, broken, cracked, or otherwise damaged piping.
d. Infiltration: Water leakage into piping.
e. Exfiltration: Water leakage from or around piping.

3. Replace defective piping using new materials and repeat inspections until defects are within allowances specified.
4. Reinspect and repeat procedure until results are satisfactory.

B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.

1. Do not enclose, cover, or put into service before inspection and approval.
2. Test completed piping systems according to requirements of authorities having jurisdiction.
3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
4. Submit separate report for each test.
5. Hydrostatic Tests: Test sanitary sewage according to requirements of authorities having jurisdiction and the following:

a. Allowable leakage is maximum of 50 gal./inch of nominal pipe size per mile (4.6 L/millimeter of nominal pipe size per kilometer) of pipe, during 24-hour period.
b. Close openings in system and fill with water.
c. Purge air and refill with water.
d. Disconnect water supply.
e. Test and inspect joints for leaks.
f. Option: Test ductile-iron piping according to AWWA C600, "Hydrostatic Testing" Section. Use test pressure of at least 10 psig (69 kPa).

6. Air Tests: Test sanitary sewage according to requirements of authorities having jurisdiction, UNI-B-6, and the following:

a. Option: Test plastic gravity sewer piping according to ASTM F 1417.
b. Option: Test concrete gravity sewer piping according to ASTM C 924 (ASTM C 924M).

7. Manholes: Perform hydraulic test according to ASTM C 969 (ASTM C 969M).

C. Leaks and loss in test pressure constitute defects that must be repaired.

D. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

3.10 CLEANING

A. Clean interior of piping of dirt and superfluous material. Flush with potable water.

END OF SECTION 221313

SECTION 223000 - PLUMBING EQUIPMENT

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

B. The Basic Materials and Methods, Section 220200, are included as a part of this Section as though written in full in this document.

1.2 SCOPE

A. The scope of the work shall include the furnishing and complete installation of the equipment covered by this Section, with all appurtenances, ready for the Owner's use.

B. Include the following work in addition to items normally part of this Section:

1. Domestic Water Heaters
2. In-line Circulator Pumps

1.3 RELATED SECTIONS

A. Section 114000 - Foodservice Equipment

B. Section 220529 - Hangers and Support for Plumbing Piping and Equipment

C. Section 220548 - Vibration and Seismic Controls for Plumbing Piping

D. Section 221000 - Plumbing Piping

E. Section 221119 - Plumbing Specialties

F. Section 260519 - Wire, Cable and Related Materials

1.4 REFERENCES

A. 10 CFR 430, Appendix E to Subpart B - Uniform Test Method for Measuring the Energy Consumption of Water Heaters; Current Edition.

B. ANSI Z21.10.3 - Gas-Fired Water Heaters, Volume III, Storage Water Heaters with Input Ratings Above 75,000 Btu Per Hour, Circulating and Instantaneous; 2019.

C. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

D. ASME BPVC-VIII-1 - Boiler and Pressure Vessel Code, Section VIII, Division 1: Rules for Construction of Pressure Vessels; 2023.

E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

F. ICC (IECC) - International Energy Conservation Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

G. NFPA 54 - National Fuel Gas Code; 2024.

H. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

I. UL 1453 - Standard for Electric Booster and Commercial Storage Tank Water Heaters; Current Edition, Including All Revisions.

J. UL 1738 - Standard for Venting Systems for Gas-Burning Appliances, Categories II, III, and IV; Current Edition, Including All Revisions.

1.5 QUALITY ASSURANCE

A. Manufacturer: For each product specified, provide components by the same manufacturer throughout.

B. Perform Work in accordance with Authorities Having Jurisdiction.

C. Provide pumps with manufacturer's name, model number, and rating/capacity identified.

D. Ensure products and installation of specified products are in conformance with recommendations and requirements of the following organizations:

1. American Gas Association (AGA).
2. National Sanitation Foundation (NSF).
3. American Society of Mechanical Engineers (ASME).
4. National Board of Boiler and Pressure Vessel Inspectors (NBBPVI).
5. National Electrical Manufacturers' Association (NEMA).
6. Underwriters Laboratories (UL).
7. American Society of Plumbing Engineers (ASPE)

E. Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, operate within 25 percent of midpoint of published maximum efficiency curve.

1.6 SUBMITTALS

A. Submit under provisions of Division One.

B. Shop Drawings:

1. Include water heater and packaged heating system dimensions, sizes and locations of all connections, and performance data.
2. Include dimensions of tanks, tank lining and insulation methods, anchors, attachments, lifting points, sizes and locations of all connections and drains.
3. Include water softening equipment dimensions, sizes and locations of all connections, performance data and capacities, backwash requirements.
4. Include booster system skid dimensions, sizes and locations of all connections, and performance data. Include such information for any field connected items, including, but not necessarily limited to, hydro-pneumatic tanks.
5. Include manufacturers' recommended space requirements, clearances, and maintenance access.

C. Product Data:

1. Include dimension drawings of water heaters indicating components and connections to other equipment and piping.
2. Indicate pump type, materials of construction, capacity, power requirements, and any affected adjacent construction.
3. Submit certified pump curves showing pump performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable.
4. Provide electrical characteristics and power and controls connection requirements/capabilities.

D. Manufacturer's Installation Instructions.

1.7 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Division One.

B. Record actual locations of equipment.

C. Provide written start-up reports.

1.8 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Division 22.

B. Operation Data: Include manufacturer's operating instructions, common trouble conditions and remedies, and trouble-shooting protocols.

C. Maintenance Data: Include routine maintenance items and corresponding intervals, identify typical replacement parts including part numbers and availability. Provide location and full

contact information including after-hours maintenance/support telephone numbers for manufacturer authorized maintenance and repair companies.

1.9 DELIVERY, STORAGE, AND HANDLING

A. DELIVERY: Deliver clearly labeled equipment to; and store, protect and handle products on site in accordance with the provisions of Division One.

B. TIMING AND COORDINATION: Arrange for delivery of equipment to allow for minimum storage time at the project site. Coordinate with the scheduled time of installation.

C. ACCEPTANCE: Accept equipment on site in original factory packaging. Inspect for damage. Damaged equipment shall not be acceptable.

D. STORAGE: Store equipment in a clean, dry location, protected from weather and damage.

1.10 EXTRA MATERIALS

A. Furnish under provisions of Division One.

B. Provide two sets of electric water heater elements.

1.11 OPERATIONS PERSONNEL TRAINING

A. Provide a training session for the owner’s operations personnel. Training session shall be performed by a qualified person who is knowledgeable in the subject system/equipment. Submit a training agenda two weeks prior to the proposed training session for review and approval.

B. Training session shall include at the minimum:

1. Purpose of equipment.
2. Principle of how the equipment works.
3. Important parts and assemblies.
4. How the equipment achieves its purpose and necessary operating conditions.
5. Most likely failure modes, causes, and corrections.
6. On site demonstration.

1.12 REGULATORY REQUIREMENTS

A. Conform to AGA, NSF, NFPA 54, NFPA 70 and UL 1453 requirements for water heaters.

B. Conform to ASME BPVC-VIII-1 for manufacture of pressure vessels for heat exchangers.

C. Conform to water heater minimum efficiency requirements prescribed by ICC (IECC) and ASHRAE Std 90.1 I-P

D. Water heaters shall be tested and rated in compliance with 10 CFR 430, Appendix E to Subpart B or ANSI Z21.10.3 as applicable.

1.13 WARRANTY

A. Provide one year warranty under provisions of Division One, unless specifically noted otherwise.

B. Warranty: Include coverage of domestic water heaters and packaged systems, water storage tanks, water softeners, and domestic pressure booster systems.

PART 2 - PRODUCTS

2.1 COMMERCIAL ELECTRIC WATER HEATERS (STORAGE TYPE)

A. Acceptable Manufacturers:

1. A.O. Smith
2. State
3. Rheem

B. Type: Factory-assembled and wired, electric, vertical storage.

C. Tank: Glass lined welded steel; 4 inch diameter inspection port (when applicable), thermally insulated with minimum 2 inches glass fiber encased in corrosion-resistant steel jacket; baked-on enamel finish.

D. Controls: Automatic water thermostat with externally adjustable temperature range from 110 to 170 degrees F (approximate, based on element configuration), replaceable elements of zinc plated copper or nickel chromium alloy, high temperature limit cutoff, enclosed controls and electrical junction box.

E. Accessories: Brass water connections and dip tube, drain valve, high-density magnesium anode, and ASME rated temperature and pressure relief valve.

F. Provide training per 1.11.

2.2 DIAPHRAGM-TYPE COMPRESSION TANKS

A. Acceptable Manufacturers:

1. Watts
2. Amtrol
3. Elbi
4. Bell and Gossett

B. Rating: Ensure suitable pressure rating of tank for expected system pressure.

C. Construction: Welded steel construction, corrosion-proof anti-microbial polypropylene liner, long-life butyl diaphragm, stainless steel system connection, factory pre-charged, complete with welded air charge fitting with protective cap. Suitable for in-line installation or factory provided with stand/legs for floor-mounted installation.

2.3 IN-LINE CIRCULATOR PUMPS

A. Acceptable Manufacturers:

1. Grundfos
2. Bell & Gossett
3. Armstrong

B. Type: Canned rotor type.

C. Housing: Bronze or stainless steel, rated for 125 psig working pressure.

D. Impeller: 304 stainless steel.

E. Shaft: Stainless steel or aluminum oxide ceramic.

F. Thermal Protection: Internal.

PART 3 - EXECUTION

3.1 WATER HEATER INSTALLATION

A. Install water heaters in accordance with manufacturer's instructions and to AGA, NSF, NFPA 54 and UL requirements.

B. Coordinate with plumbing piping and related work to achieve operating system.

C. Provide intake air/venting and associated piping in accordance with both code requirements and manufacturer's recommendations. The material and installation provided must not only be compatible with the equipment served but must also be suited to and acceptable per project conditions. Any material to be provided in a return air plenum must be compliant for such use. Any plastic piping must be UL 1738 certified and where located outdoors shall be painted with latex paint for UV protection.

D. Provide a properly sized thermal expansion tank downstream of the associated check valve in the cold water supply to the heater.

E. Provide a thermometer at the hot water outlet piping from each water heater.

F. Provide a line sized shut-off valve in the cold water supply to and in the hot water outlet from each heater, close to each heater.

G. Provide approved heat traps at all storage type water heaters not furnished from the manufacturer with integral heat traps or heat trap nipples.

H. Provide a line size plug cock in the gas supply close to each gas-fired water heater.

I. Provide approved dielectric couplings at all hot and cold water connections to each heater/tank, and at the T&P relief valve connection.

J. All tank type water heaters with more than 20 gallons of storage capacity shall be floor mounted on a concrete housekeeping pad, unless specifically indicated otherwise on the Drawings.

K. Each tank type water heater shall be installed within a suitably sized galvanized drain pan. Securely elevate the base of each heater above the floor of the drain pan with structurally sound, non-ferrous, non-absorbent supports. Drain pan shall have no less than a 3/4" piped drain outlet.

L. All water heater drain lines shall be full size, copper, and routed to indirect waste receptors.

M. Startup:

1. Startup of all water heaters shall be in strict accordance with manufacturer's recommendations.
2. Ensure that storage type water heaters are full of water and downstream fixtures have been run for no less than 3 minutes in order to purge any trapped air from the water heater tank prior to heater startup.

3.2 PUMP INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide air cock and drain connection on horizontal pump casings.

C. Provide line sized isolating valve and strainer on suction and line sized soft seated check valve and balancing valve on discharge.

D. Provide line sized isolating valve and strainer at inlet and line sized soft seated check valve and line sized isolating valve at outlet of each in line circulator pump. Provide unions on both sides of pump.

E. Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.

F. Align and verify alignment of base mounted pumps prior to start-up. Provide alignment certificate to engineer prior to start-up.

3.3 WATER SOFTENER INSTALLATION

A. Arrange piping for easy dismantling to permit cleaning and service.

B. Install the system in accordance with the manufacturer's installation, start-up and service instructions.

C. Provide a complete set of instructions covering the installation, operation and servicing of the water softener.

D. Provide system manufacturer start-up service.

1. Provide the services of factory trained service technicians to start up the system. Technicians shall be trained and experienced on the work they conduct. Technician shall possess a current Class III WTS License from TCEQ.
2. Provide and fill the brine tank with enough food grade pellet salt for ten (10) regenerations at maximum brining.
3. Monitor the operation of the softener and set the time clock for an average period between cycles so that regeneration occurs in the early morning hours during a period of zero usage
4. Follow the manufacturer's start up procedures.

    a. Verify interlocks.
    b. Test and verify operation of controls.
    c. Calibrate controls.

3.4 DOMESTIC HOT WATER STORAGE TANK INSTALLATION

A. Install tanks in accordance with manufacturer's instructions.

B. Provide steel pipe support for tanks, independent of building structural framing members.

C. Clean and flush tank after installation. Seal until pipe connections are made.

END OF SECTION 223000

SECTION 224000 - PLUMBING FIXTURES

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

B. Section 220200 - Basic Materials and Methods for Plumbing shall be included as a part of this Section as though written in full in this document.

1.2 SCOPE

A. The scope of the work shall include the furnishing and complete installation of the fixtures covered by this Section, with all appurtenances, ready for the Owner’s use.

B. Include the following work in addition to items normally part of this Section:

1. Plumbing Fixtures
2. Fixture Carriers
3. Faucets, Supplies, and Trim
4. Flushometers

1.3 RELATED WORK

A. Section 220529 - Hangers and Support for Plumbing Piping and Equipment

B. Section 221000 - Plumbing Piping

C. Section 221119 - Plumbing Specialties

D. Section 223000 - Plumbing Equipment

1.4 REFERENCES

A. ASME A112.4.3 - Plastic Fittings for Connecting Water Closets to the Sanitary Drainage System

B. ASME A112.6.1M - Floor-Affixed Supports for Off-the-Floor Plumbing Fixtures for Public Use; 1997 (Reaffirmed 2017).

C. ASME A112.18.1 - Plumbing Supply Fittings

D. ASME A112.18.2 - Plumbing Waste Fittings

E. ASME A112.18.9 - Protectors/Insulators for Exposed Waste and Supplies on Accessible Fixtures

F. ASME A112.19.1 - Enameled Cast Iron and Enameled Steel Plumbing Fixtures

G. ASME A112.19.2 - Ceramic Plumbing Fixtures

H. ASME A112.19.3 - Stainless Steel Plumbing Fixtures

I. ASME A112.19.7 - Hydromassage Bathtub Systems

J. NSF/ANSI 61 - Drinking Water System Components - Health Effects

K. ANSI Z358.1 - Emergency Eyewash and Shower Equipment

L. ASSE 1016 - Performance Requirements for Individual Thermostatic, Pressure Balancing, and Combination Pressure Balancing and Thermostatic Control Valves for Individual Fixture Fittings.

M. ASSE 1037 - Performance Requirements for Pressurized Flushing Devices for Plumbing Fixtures

N. ADA (Americans with Disabilities Act)

O. TAS (Texas Accessibility Standards)

1.5 QUALITY ASSURANCE

A. Manufacturer: For each product specified, provide components by the same manufacturer throughout.

B. Warranty: Warrant the work specified herein for one year against becoming unserviceable or causing an objectionable appearance resulting from defective or non-conforming materials and workmanship.

C. Defects shall include, but not necessarily be limited to, the following:

1. Noisy operation.
2. Noticeable deterioration of finish.
3. Leakage of water.

1.6 SUBMITTALS

A. Submit under provisions of Division One.

B. Submit product data under provisions of Division One.

C. Include component sizes, rough-in requirements, service sizes, finishes, materials, dimensions, performance information, and accessories.

D. Manufacturer’s Installation Instructions: Indicate assembly and support requirements.

1.7 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Division One.

B. Provide pre-printed operating and maintenance instructions for each specified item. Instruct and demonstrate proper operation and maintenance to the Owner's designated representative.

1.8 DELIVERY, STORAGE, AND HANDLING

A. DELIVERY: Deliver clearly labeled specialties to; and store, protect and handle products on site in accordance with the provisions of Division One.

B. TIMING AND COORDINATION: Arrange for delivery of materials to allow for minimum storage time at the project site. Coordinate with the scheduled time of installation.

C. ACCEPTANCE: Accept specialties on site in original factory packaging. Inspect for damage. Damaged specialties shall not be acceptable.

D. STORAGE: Store materials in a clean, dry location, protected from weather and damage.

1.9 FIELD MEASUREMENTS

A. Verify that field measurements are as indicated on the Contract Documents.

B. Confirm and field coordinate that millwork is constructed with adequate provisions for the installation of counter top lavatories and sinks.

PART 2 - PRODUCTS

2.1 PLUMBING FIXTURES

A. GENERAL: Provide plumbing fixtures in accordance with manufacturer’s recommendations and as indicated and scheduled on Drawings. Acceptable manufacturers of each fixture type are as indicated below.

1. Provide floor-affixed fixture carriers as appropriate for all wall-hung plumbing fixtures unless specifically noted otherwise.
2. Fixture drilling shall match faucet spread and match any related trim and accessories.

B. WATER CLOSETS, URINALS, LAVATORIES (Vitreous China)

1. American Standard
2. Kohler
3. Zurn

4. Toto

C. MOP SINKS

1. Stern-Williams
2. Fiat
3. Acorn

D. DRINKING FOUNTAINS AND WATER COOLERS

1. Halsey Taylor
2. Elkay

2.2 FAUCETS, SUPPLIES, AND TRIM

A. GENERAL: Provide faucets, supplies, and trim in accordance with manufacturer's recommendations, as appropriate for fixtures to be served, and as indicated and scheduled on Drawings. Acceptable manufacturers for each type of appurtenance are as indicated below.

1. Flushometer flush rate shall match gallon-per-flush criteria of fixtures served.
2. Strainers shall be heavy cast brass chrome plated with matching grid type strainer, with or without overflow as required, 17 gauge seamless brass tailpiece of length determined by installation requirements. Provide complete with washers and brass locknut.
3. P-traps shall be 17 gauge seamless chrome plated brass, adjustable type. Provide complete with cleanout plug, chrome plated brass slip nuts, wall bend, and wrought brass escutcheon of depth determined by installation requirements.
4. Angle stops shall be lead-free commercial pattern chrome plated brass, quarter turn ball type with loose key handles. Provide complete with chrome plated copper supply risers and wrought brass escutcheon of depth determined by installation requirements.
5. Toilet seats shall be commercial grade and provided complete with stainless steel posts and self-sustaining check hinges.
6. Pipe trim insulation shall be compliant, white molded vinyl, fade/discoloration-resistant, bacteria/fungal-resistant insulation.
7. Where an exposed flush valve assembly will conflict with the installation height of a grab bar or where there will be insufficient clearance above the top cover of an exposed flush valve for maintenance access relative to the installation height of a grab bar, provide an offset type flush valve tube. Make water rough-in and other adjustments as necessary for a compliant and functioning installation.

B. FAUCETS

1. Chicago

C. SHOWER VALVES

1. Acorn
2. Bradley
3. Chicago

D. FLUSHOMETERS

1. Sloan
2. Zurn

E. SUPPLY STOPS

1. McGuire
2. Zurn
3. Chicago
4. Kohler

F. CHROME PLATED TUBULAR BRASS

1. McGuire
2. Zurn
3. Kohler

G. TOILET SEATS

1. Church
2. Bemis
3. Toto
4. Centoco
5. Beneke
6. Olsonite

H. PIPE TRIM INSULATION

1. Truebro
2. McGuire
3. Plumberex

2.3 FIXTURE CARRIERS

A. GENERAL: ASME A112.6.1M; Provide floor-affixed fixture carriers as appropriate for all wall-hung plumbing fixtures unless specifically noted otherwise. Fixture carrier foot supports shall be securely anchored to the floor with 1/2” bolts and anchors at all locations.

1. Chair type carriers shall be adjustable, with coated cast iron body with integral no hub waste and vent connections, complete with gasketed adjustable faceplate assembly, adjustable nipple with test cap, neoprene bowl gasket, lugs for floor and wall attachment, threaded fixture studs, and hardware. Provide single or double type of vertical or horizontal configuration as required and with auxiliary inlet as required.
2. Lavatory carriers shall be adjustable, with steel uprights and welded base feet, coated cast iron support brackets, cast or ductile iron concealed support arms, alignment rod, complete with leveling and support hardware. Provide single or back to back configuration as required.

3. Drinking fountain and urinal carriers shall be adjustable, with steel uprights and welded base feet, upper and lower bearing plates, threaded rods, and mounting hardware. Provide single or side-by-side configuration as required.

B. ACCEPTABLE MANUFACTURERS

1. J.R. Smith
2. Zurn
3. Watts
4. Wade
5. Josam

PART 3 - EXECUTION

3.1 PREPARATION

A. EXAMINATION OF CONDITIONS: Examine conditions affecting this work. Report unsatisfactory conditions to the proper authority and do not proceed until those conditions have been corrected. Commencing work implies acceptance of existing conditions as satisfactory to the outcome of this work.

B. Coordinate cutting of floor construction to receive drains to required invert elevations.

3.2 INSTALLATION

A. Install fixtures in locations and heights as shown on Drawings and as directed by the Architect.

B. Install materials plumb, level, securely, and in accordance with manufacturer's recommendations.

C. All rough-in pipe openings for final connections with supply, waste, vent, and storm systems shall be closed with caps or plugs during early stages of construction and installation. Tape shall not be considered sufficient protection.

D. Rough-in fixture piping connections in accordance with minimum sizes indicated in fixture rough-in schedule for particular fixtures.

E. Provide ball valves in piping serving batteries of fixtures. Label stops "Hot" and "Cold." Valves shall be located above accessible ceilings. If ceilings are not accessible, provide access panels of adequate size to ensure valves are fully accessible and can be fully operated.

F. Provide lockable ball valves in piping serving emergency safety fixtures and clearly label such valves as to the fixtures served.

G. Plumbing fixtures shall be supported by a concealed carrier where required to properly support the fixture specified. All carriers to be securely mounted, bolted and checked prior to concealment.

H. Caulk around fixtures with best grade white silicone caulking. Do not use grout.

I. All handles on supply and drainage fittings or other brass items shall be properly lined up and adjusted. Fittings shall not be left in any haphazard manner.

J. Fixtures shall have individual chrome plated heavy pattern loose key quarter-turn cutoff stops on supply lines, complete with escutcheons. Where same are not specified as a part of the fixture trim, they shall be installed as close to fixtures as possible in the hot and cold water supply. A loose key for each stop shall be provided to the Owner.

K. Install each fixture with trap, easily removable for servicing and cleaning.

L. All showers and similar installations shall be installed with type “L” copper pipe between shower valve and shower head rough-in. The termination point shall have a brass drop ear elbow for shower head arm connection. Contractor shall provide proper anchoring support.

3.3 INTERFACE WITH OTHER PRODUCTS

A. Review millwork shop drawings. Confirm location and size of fixtures and openings before rough-in and installation.

B. Review architectural drawings. Confirm configuration and orientation of shower controls and trim prior to rough-in and installation.

3.4 ADJUSTING

A. Adjust work under provisions of Division One.

B. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.

3.5 CLEANING

A. Clean work under provisions of Division One.

B. At completion clean plumbing fixtures and appurtenances.

3.6 PROTECTION OF FINISHED WORK

A. Protect finished Work under provisions of Division One.

B. Do not permit use of fixtures.

3.7 ADA ACCESSIBLE FIXTURES

A. At all locations required to be accessible, such fixtures, controls, and final installations shall comply with the requirements of ADA and any applicable state accessibility standards. Install fixtures to heights, indicated on architectural drawings.

B. All exposed water supply and drain pipes under accessible lavatories and sinks shall be insulated with securely fastened pipe trim insulation kits of the proper model for the fixtures specified.

C. Wall mounted drinking fountains and coolers which protrude into passages or corridor space, whether single or paired with an adjacent accessible fixture, shall be supplied with a matching skirt or apron to lower the underside clearance of the non-accessible fixture equal to that required for accessible fixture.

END OF SECTION 224000

SECTION 230200 - BASIC MATERIALS AND METHODS FOR HVAC

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all Work herein.

B. The Contract Drawings indicate the extent and general arrangement of the systems. If any departure from the Contract Drawings is deemed necessary by the Contractor, details of such departures and the reasons, therefore, shall be submitted to the Architect/Engineer for review as soon as practicable. No such departures shall be made without the prior written approval of the Architect/Engineer.

C. Notwithstanding any reference in the Specifications to any article, device, product, material, fixture, form or type of construction by name, make or catalog number, such reference shall not be construed as limiting competition; and the Contractor, in such cases, may at his option use any article, device, product, material, fixture, form or type of construction which in the judgment of the Architect/Engineer, expressed in writing, is the equivalent of that specified.

1.2 SCOPE OF WORK

A. The Work included under this Contract consists of the furnishing and installation of all equipment and material necessary and required to form complete and functioning systems in all of their various phases, all as shown on the accompanying Drawings and/or described in these Specifications. The Contractor shall review all pertinent drawings, including those of other contracts, prior to commencement of Work.

B. This Division requires the furnishing and installing of all items as specified herein, indicated on the Drawings or reasonably inferred as necessary for safe and proper operation; including every article, device or accessory (whether or not specifically called for by item) reasonably necessary to facilitate each system's functioning as indicated by the design and the equipment specified. Elements of the work include, but are not limited to, materials, labor, supervision, transportation, storage, equipment, utilities, all required permits, licenses and inspections. All work performed under this Section shall be in accordance with the Project Manual, Drawings and Specifications and is subject to the terms and conditions of the Contract.

C. The approximate locations of Mechanical (HVAC) items are indicated on the Drawings. These Drawings are not intended to give complete and accurate details in regard to location of outlets, apparatus, 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 Engineer, who reserves the right to make any reasonable changes in the locations indicated without additional cost to the Owner.

D. 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.

E. All discrepancies between the Contract Documents and actual job-site conditions shall be reported to the Owner or Engineer so that they will be resolved prior to bidding. Where this cannot be done at least 7 working days prior to bid; the greater or more costly of the discrepancy shall be bid. All labor and materials required to perform the work described shall be included as part of this Contract.

F. It is the intention of this Section of the Specifications to outline minimum requirements to furnish the Owner with a turn-key and fully operating system in cooperation with other trades.

G. It is the intent of the above "Scope" to give the Contractor a general outline of the extent of the Work involved; however, it is not intended to include each and every item required for the Work. Anything omitted from the "Scope" but shown on the Drawings, or specified later, or necessary for a complete and functioning heating, ventilating and air conditioning system shall be considered a part of the overall "Scope".

H. The Contractor shall rough-in fixtures and equipment furnished by others from rough-in and placement drawings furnished by others. The Contractor shall make final connection to fixtures and equipment furnished by others.

I. The Contractor shall participate in the commissioning process as required; including, but not limited to, meeting attendance, completion of checklists, and participation in functional testing.

1.3 SCHEMATIC NATURE OF CONTRACT DOCUMENTS

A. 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 reviewed shop drawings.

B. All duct or pipe or equipment locations as indicated on the documents do not indicate every transition, offset, or exact location. All transitions, offsets, clearances and exact locations shall be established by actual field measurements, coordination with the structural, architectural and reflected ceiling plans, and other trades. Submit shop drawings for review.

C. All transitions, offsets and relocations as required by actual field conditions shall be performed by the Contractor at no additional cost to the Owner.

D. Additional coordination with electrical contractor may be required to allow adequate clearances of electrical equipment, fixtures and associated appurtenances. Contractor to notify Architect and Engineer of unresolved clearances, conflicts or equipment locations.

1.4 SITE VISIT AND FAMILIARIZATION

A. Before submitting a bid, it will be necessary for each Contractor whose work is involved to visit the site and ascertain for himself the conditions to be met therein in installing his work and

make due provision for same in his bid. It will be assumed that this Contractor in submitting his bid has visited the premises and that his bid covers all work necessary to properly install the equipment shown. Failure on the part of the Contractor to comply with this requirement shall not be considered justification for the omission or faulty installation of any work covered by these Specifications and Drawings.

B. Understand the existing utilities from which services will be supplied; verify locations of utility services and determine requirements for connections.

C. Determine in advance that equipment and materials proposed for installation fit into the confines indicated.

1.5 WORK SPECIFIED IN OTHER SECTIONS

A. Finish painting is specified. Prime and protective painting are included in the work of this Division.

B. Owner and General Contractor furnished equipment shall be properly connected to Mechanical (HVAC) systems.

C. Furnishing and installing all required Mechanical (HVAC) equipment control relays and electrical interlock devices, conduit, wire and J-boxes are included in the Work of this Division.

1.6 PERMITS, TESTS, INSPECTIONS

A. Arrange and pay for all permits, fees, tests, and all inspections as required by government authorities.

1.7 DATE OF SUBSTANTIAL COMPLETION

A. The date of final acceptance shall be the date of substantial completion. Refer to Division One for additional requirements.

B. The date of final acceptance shall be documented in writing and signed by the Architect, Owner and Contractor.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to the project properly identified with names, model numbers, types, grades, compliance labels, and other information needed for identification.

B. Deliver products to the project at such time as the project is ready to receive the equipment, pipe or duct - properly protected from incidental damage and weather damage.

C. Damaged equipment, duct or pipe, shall be promptly removed from the site and new, undamaged equipment, pipe or duct shall be installed in its place promptly with no additional charge to the Owner.

1.9 NOISE AND VIBRATION

A. The heating, ventilating and air conditioning systems, and the component parts thereof, shall be guaranteed to operate without objectionable noise and vibration.

B. Provide foundations, supports and isolators as specified or indicated, properly adjusted to prevent transmission of vibration to the building structure, piping and other items.

C. Carefully fabricate ductwork and fittings with smooth interior finish to prevent turbulence and generation or regeneration of noise.

D. All equipment shall be selected to operate with minimum of noise and vibration. If, in the opinion of the Architect, objectionable noise or vibration is produced or transmitted to or through the building structure by equipment, piping, ducts or other parts of the Work, the Contractor shall rectify such conditions without extra cost to the Owner.

1.10 DELEGATED DESIGN FOR ANCHORAGE OF ROOF MOUNTED EQUIPMENT

A. The Contractor shall engage a qualified professional engineer to design all roof mounted equipment curbs, equipment supports, equipment tie downs, equipment connections, and methods of attachment for components that are to be anchored to the building structure. The design shall comply with wind load and uplift requirements utilizing design criteria per ICC (IBC) and ASCE 7 unless criteria is otherwise indicated in the Construction Documents.

B. Submittal: Signed and sealed engineering analysis data and accompanying details, drawings, and supplemental installation information shall be submitted to the engineer for review.

1.11 APPLICABLE CODES AND STANDARDS

A. Obtain all required permits and inspections for all work required by the Contract Documents and pay all required fees in connection thereof.

B. Arrange with the serving utility companies for the connection of all required utilities and pay all charges, meter charges, connection fees and inspection fees, if required.

C. Comply with all applicable codes, specifications, local ordinances, industry standards, utility company regulations and the applicable requirements which includes and is not limited to the following nationally accepted codes and standards:

1. Air Moving & Conditioning Association, AMCA.
2. American Standards Association, ASA.
3. American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc., ASHRAE.
4. American Society of Mechanical Engineers, ASME.
5. American Society of Plumbing Engineers, ASPE.
6. American Society of Testing Materials, ASTM.
7. American Water Works Association, AWWA.
8. National Bureau of Standards, NBS.

9. National Fire Protection Association, NFPA.
10. Sheet Metal & Air Conditioning Contractors' National Association, SMACNA.
11. Underwriters' Laboratories, Inc., UL.
12. International Building Code, IBC.
13. International Energy Conservation Code, IECC.
14. International Fire Code, IFC.
15. International Fuel Gas Code, IFGC.
16. International Mechanical Code, IMC.

D. Where differences existing between the Contract Documents and applicable state or city building codes, state and local ordinances, industry standards, utility company regulations and the applicable requirements of the nationally accepted codes and standards, the more stringent or costly application shall govern. Promptly notify the Engineer in writing of all differences.

E. When directed in writing by the Engineer, remove all work installed that does not comply with the Contract Documents and applicable state or city building codes, state and local ordinances, industry standards, utility company regulations and the applicable requirements of the above listed nationally accepted codes and standards, correct the deficiencies, and complete the work at no additional cost to the Owner.

1.12 DEFINITIONS AND SYMBOLS

A. General Explanation: A substantial amount of construction and Specification language constitutes definitions for terms found in other Contract Documents, including Drawings which must be recognized as diagrammatic and schematic in nature and not completely descriptive of requirements indicated thereon. Certain terms used in Contract Documents are defined generally in this article, unless defined otherwise in Division 01.

B. Definitions and explanations of this Section are not necessarily either complete or exclusive but are general for work to the extent not stated more explicitly in another provision of the Contract Documents.

C. Indicated: The term "Indicated" is a cross-reference to details, notes or schedules on the Drawings, to other paragraphs or schedules in the Specifications and to similar means of recording requirements in Contract Documents. Where such terms as "Shown", "Noted", "Scheduled", "Specified" and "Detailed" are used in lieu of "Indicated", it is for the purpose of helping the reader locate cross-reference material, and no limitation of location is intended except as specifically shown.

D. Directed: Where not otherwise explained, terms such as "Directed", "Requested", "Accepted", and "Permitted" mean by the Architect or Engineer. However, no such implied meaning will be interpreted to extend the Architect's or Engineer's responsibility into the Contractor's area of construction supervision.

E. Reviewed: Where used in conjunction with the Engineer's response to submittals, requests for information, applications, inquiries, reports and claims by the Contractor the meaning of the term "Reviewed" will be held to limitations of Architect's and Engineer's responsibilities and duties as specified in the General and Supplemental Conditions. In no case will be “Reviewed”

by Engineer be interpreted as a release of the Contractor from responsibility to fulfill the terms and requirements of the Contract Documents.

F. Furnish: Except as otherwise defined in greater detail, the term "Furnish" is used to mean supply and deliver to the project site, ready for unloading, unpacking, assembly, installation, etc., as applicable in each instance.

G. Install: Except as otherwise defined in greater detail, the term "Install" is used to describe operations at the project site including unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protection, cleaning and similar operations, as applicable in each instance.

H. Provide: Except as otherwise defined in greater detail, the term "Provide" is used to mean "Furnish and Install", complete and ready for intended use, as applicable in each instance.

I. Installer: 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 site, including unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protection, cleaning and similar operations, as applicable in each instance. It is a general requirement that such entities (Installers) be expert in the operations they are engaged to perform.

J. Imperative Language: Used generally in Specifications. Except as otherwise indicated, requirements expressed imperatively are to be performed by the Contractor. For clarity of reading at certain locations, contrasting subjective language is used to describe responsibilities that must be fulfilled indirectly by the Contractor or, when so noted, by other identified installers or entities.

K. Minimum Quality/Quantity: In every instance, the quality level or quantity shown or specified is intended as minimum quality level or quantity of work to be performed or provided. Except as otherwise specifically indicated, the actual work may either comply exactly with that minimum (within specified tolerances) or may exceed that minimum within reasonable tolerance limits. In complying with requirements, indicated or scheduled numeric values are either minimums or maximums as noted or as appropriate for the context of the requirements. Refer instances of uncertainty to Owner or Engineer via a request for information (RFI) for decision before proceeding.

L. Abbreviations and Symbols: The language of Specifications and other Contract Documents including Drawings is of an abbreviated type in certain instances and implies words and meanings which will be appropriately interpreted. Actual word abbreviations of a self-explanatory nature have been included in text of Specifications and Drawings. Specific abbreviations and symbols 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 or on a Legend and Symbol Drawing. Trade and industry association names and titles of generally recognized industry 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 Contract Documents so indicate. Except as otherwise indicated, graphic symbols and abbreviations used on Drawings and in Specifications are those recognized in construction industry for indicated purposes. Where not otherwise noted symbols and abbreviations are

defined by the latest ASHRAE Fundamentals Handbook, chapter 34 "Abbreviations and Symbols", ASME and ASPE published standards.

1.13 DRAWINGS AND SPECIFICATIONS

A. These Specifications are intended to supplement the Drawings and it will not be the province of the Specifications to mention any part of the Work which the Drawings are competent to fully explain in every particular and such omission is not to relieve the Contractor from carrying out portions indicated on the Drawings only.

B. Should items be required by these Specifications and not indicated on the Drawings, they are to be supplied even if of such nature that they could have been indicated thereon. In case of disagreement between Drawings and Specifications, or within either Drawings or Specifications, the better quality or greater quantity of work shall be estimated and the matter referred to the Architect or Engineer for review with a request for information and clarification at least 7 working days prior to bid opening date for issuance of an addendum.

C. The listing of product manufacturers, materials and methods in the various sections of the Specifications, and indicated on the Drawings, is intended to establish a standard of quality only. It is not the intention of the Owner or Engineer to discriminate against any product, material or method that is the equivalent of the standards as indicated and/or specified, nor is it intended to preclude open, competitive bidding. The fact that a specific manufacturer is listed as an acceptable manufacturer should not be interpreted to mean that the manufacturer’s standard product will meet the requirements of the project design, Drawings, Specifications and space constraints.

D. The Architect or Engineer and Owner shall be the sole judge of quality and equivalence of equipment, materials and methods.

E. Products by other reliable manufacturers, other materials, and other methods, will be accepted as outlined, provided they have equivalent capacity, construction, and performance. However, under no circumstances shall any substitution be made without the written permission of the Architect or Engineer and Owner. Request for prior approval must be made in writing 10 calendar days prior to the bid date without fail.

F. Wherever a definite product, material or method is specified and there is not a statement that another product, material or method will be acceptable, it is the intention of the Owner or Engineer that the specified product, material or method is the only one that shall be used without prior approval.

G. Wherever a definite material or manufacturer's product is specified and the Specification states that products of similar design and equivalent construction from the specified list of manufacturers may be substituted, it is the intention of the Owner or Engineer that products of manufacturers that are specified are the only products that will be acceptable and that products of other manufacturers will not be considered for substitution without approval.

H. Wherever a definite product, material or method is specified and there is a statement that "OR EQUIVALENT" product, material or method will be acceptable, it is the intention of the Owner or Engineer that the specified product, material or method or an "OR EQUIVALENT" product,

material or method may be used if it complies with the Specifications and is submitted for review to the Engineer as outline herein.

I. Where permission to use substituted or alternative equipment on the project is granted by the Owner or Engineer in writing, it shall be the responsibility of the Contractor or Subcontractor involved to verify that the equipment will fit in the space available which includes allowances for all required Code and maintenance clearances, and to coordinate all equipment structural support, plumbing and electrical requirements and provisions with the Mechanical (HVAC) Design Documents and all other trades, including Division 26.

J. Changes in architectural, structural, electrical, mechanical, and plumbing requirements for the substitution shall be the responsibility of the bidder wishing to make the substitution. This shall include the cost of redesign by the affected designer(s). Any additional cost incurred by affected Subcontractors shall be the responsibility of this bidder and not the Owner.

K. If any request for a substitution of product, material or method is rejected, the Contractor will automatically be required to furnish the product, material or method named in the Specifications. Repetitive requests for substitutions will not be considered.

L. The Owner or Engineer will investigate all requests for substitutions when submitted in accordance with the requirements listed above; and if accepted, will issue a letter allowing the substitutions.

M. Where equipment other than that used in the design as specified or shown on the Drawings is substituted (either from an approved manufacturers list or by submittal review), it shall be the responsibility of the substituting Contractor to coordinate space requirements, building provisions and connection requirements with their respective trade(s) and all other trades; and to pay all additional costs to other trades, the Owner, the Architect or Engineer, if any, due to the substitutions.

1.14 SUBMITTALS

A. Coordinate with Division 01 for submittal timetable requirements, unless noted otherwise within thirty (30) days after the Contract is awarded. The Contractor shall submit an electronic copy of a complete set of shop drawings and complete data covering each item of equipment or material. The submittal of each item requiring a submittal must be received by the Architect or Engineer within the above thirty-day period. The Architect or Engineer shall not be responsible for any delays or costs incurred due to excessive shop drawing review time for submittals received after the thirty (30) day time limit. The Architect and Engineer will retain a copy of all shop drawings for their files. All literature pertaining to items subject to Shop Drawing submittal shall be submitted at one time. Submittals shall be placed in one electronic file in PDF 8.0 format and bookmarked for individual specification sections. Individual electronic files of submittals for individual specifications shall not be permitted. Each submittal shall include the following items:

1. A cover sheet with the names and addresses of the Project, Architect, MEP Engineer, General Contractor and the Subcontractor making the submittal. The cover sheet shall also contain the section number covering the item or items submitted and the item nomenclature or description.

2. An index page with a listing of all data included in the Submittal.
3. A list of variations page with a listing of all variations, including unfurnished or additional required accessories, items or other features, between the submitted equipment and the specified equipment. If there are no variations, then this page shall state "NO VARIATIONS". Where variations affect the work of other Contractors, then the Contractor shall certify on this page that these variations have been fully coordinated with the affected Contractors and that all expenses associated with the variations will be paid by the submitting Contractor. This page will be signed by the submitting Contractor.
4. Equipment information including manufacturer's name and designation, size, performance and capacity data as applicable. All applicable Listings, Labels, Approvals and Standards shall be clearly indicated.
5. Dimensional data and scaled drawings as applicable to show that the submitted equipment will fit the space available with all required Code and maintenance clearances clearly indicated and labeled at a minimum scale of 1/4" = 1'-0", as required to demonstrate that the alternate or substituted product will fit in the space available.
6. Identification of each item of material or equipment matching that indicated on the Drawings.
7. Sufficient pictorial, descriptive and diagrammatic data on each item to show its conformance with the Drawings and Specifications. Any options or special requirements or accessories shall be so indicated. All applicable information shall be clearly indicated with arrows or another approved method.
8. Additional information as required in other Sections of this Division.
9. Certification by the General Contractor and Subcontractor that the material submitted is in accordance with the Drawings and Specifications, signed and dated in long hand. Submittals that do not comply with the above requirements shall be returned to the Contractor and shall be marked "REVISE AND RESUBMIT".

B. Refer to Division 00 and Division 01 for additional information on shop drawings and submittals.

C. Equipment and materials submittals and shop drawings will be reviewed for compliance with design concept only. It will be assumed that the submitting Contractor has verified that all items submitted can be installed in the space allotted. Review of shop drawings and submittals shall not be considered as a verification or guarantee of measurements or building conditions.

D. Where shop drawings and submittals are marked "REVIEWED", the review of the submittal does not indicate that submittals have been checked in detail nor does it in any way relieve the Contractor from his responsibility to furnish material and perform work as required by the Contract Documents.

E. Shop drawings shall be reviewed and returned to the Contractor with one of the following categories indicated:

1. REVIEWED: Contractor need take no further submittal action, shall include this submittal in the O&M manual and may order the equipment submitted on.
2. REVIEWED AS NOTED: Contractor shall submit a letter verifying that required exceptions to the submittal have been received and complied with including additional accessories or coordination action as noted and shall include this submittal and compliance letter in the O&M manual. The contractor may order the equipment

submitted on at the time of the returned submittal providing the Contractor complies with the exceptions noted.

3. NOT APPROVED: Contractor shall resubmit new submittal on material, equipment or method of installation when the alternate or substitute is not approved. The Contractor will automatically be required to furnish the product, material or method named in the Specifications and/or Drawings. Contractor shall not order equipment that is not approved. Repetitive requests for substitutions will not be considered.
4. REVISE AND RESUBMIT: Contractor shall resubmit new submittal on material, equipment or method of installation when the alternate or substitute is marked revise and resubmit. The Contractor will automatically be required to furnish the product, material or method named in the Specifications and/or provide as noted on previous shop drawings. Contractor shall not order equipment marked revise and resubmit. Repetitive requests for substitutions will not be considered.
5. CONTRACTOR'S CERTIFICATION REQUIRED: Contractor shall resubmit submittal on material, equipment or method of installation. The Contractor's stamp is required stating that the submittal meets all conditions of the Contract Documents. The stamp shall be signed by the General Contractor. The submittal will not be reviewed if the stamp is not placed and signed on all shop drawings.
6. MANUFACTURER NOT AS SPECIFIED: Contractor shall resubmit new submittal on material, equipment or method of installation when the alternate or substitute is marked manufacturer not as specified. The Contractor will automatically be required to furnish the product, material or method named in the Specifications. Contractor shall not order equipment when submittal is marked manufacturer not as specified. Repetitive requests for substitutions will not be considered.

F. Materials and equipment which are purchased or installed without submittal review shall be at the risk of the Contractor and the cost for removal and replacement of such materials and equipment and related work which is judged unsatisfactory by the Owner or Engineer for any reason shall be at the expense of the Contractor. The responsible Contractor shall remove the material and equipment noted above and replace it with specified equipment or material at his own expense when directed in writing by the Architect or Engineer.

G. Shop Drawing Submittals shall be complete and checked prior to submission to the Engineer for review.

H. Submittals are required for, but not limited to, the following items subject to project requirements:

1. Coordination Drawings
2. Common Motor Requirements for HVAC Equipment
3. Expansion Fittings and Loops for HVAC Piping
4. Variable Frequency Motor Speed Control for HVAC Equipment
5. Hangers and Support for Piping and Equipment HVAC
6. Vibration and Seismic Controls for HVAC Piping and Equipment
7. Testing, Adjusting, and Balancing
8. Duct Insulation
9. HVAC Piping Insulation
10. Above Ground Hydronic Piping
11. Hydronic Specialties
12. Refrigerant Piping

13. Metal Ductwork
14. Ductwork Accessories
15. HVAC Fans
16. Air Distribution Devices
17. HVAC Gravity Ventilators
18. Air Filters
19. Energy Recovery Ventilator
20. Modular Indoor Central Station Air Handling Units
21. Split System Air-Conditioners - Wall-Mounted

I. Refer to other Division 23 sections for additional submittal requirements. Provide samples of actual materials and/or equipment to be used on the Project upon request of the Owner or Engineer.

1.15 COORDINATION DRAWINGS

A. Prepare coordination drawings to a scale of 1/4"=1'-0" or larger, detailing major elements, components, and systems of mechanical equipment and materials in relationship with other systems, installations, and building components. Indicate locations where space is limited for installation and access, and where sequencing and coordination of installations are of importance to the efficient flow of the Work, including (but not necessarily limited to) the following:

1. Indicate the proposed locations of pipe, duct, equipment, and other materials. Include the following:

    a. Wall and type locations.
    b. Clearances for installing and maintaining insulation.
    c. Locations of light fixtures and sprinkler heads.
    d. Clearances for servicing and maintaining equipment, including tube removal, filter removal, and space for equipment disassembly required for periodic maintenance.
    e. Equipment connections and support details.
    f. Exterior wall and foundation penetrations.
    g. Routing of storm and sanitary sewer piping.
    h. Fire-rated wall and floor penetrations.
    i. Sizes and location of required concrete pads and bases.
    j. Valve stem movement.
    k. Structural floor, wall and roof opening sizes and details.

2. Indicate scheduling, sequencing, movement, and positioning of large equipment into the building during construction.
3. Prepare floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.
4. Prepare reflected ceiling plans to coordinate and integrate installations, air distribution devices, light fixtures, communication systems components, and other ceiling-mounted items.

B. This Contractor shall be responsible for coordination of all items that will affect the installation of the work of this Division. This coordination shall include, but not be limited to: voltage,

ampacity, capacity, electrical and piping connections, space requirements, sequence of construction, building requirements and special conditions.

C. By submitting coordination drawings on the project, this Contractor indicates that all necessary coordination has been completed and that the systems, products and equipment submitted can be installed in the building and will operate as specified and intended, in full coordination with all other Contractors and Subcontractors.

1.16 RECORD DOCUMENTS

A. Prepare Record Documents in accordance with the requirements of Division 00 and Division 01, in addition to the requirements specified in Division 23.

B. The Contractor shall maintain a separate set of clearly and legibly marked Record Drawings on the job site to record all changes and modifications, including, but not limited to the following: work details, alterations to meet site conditions, and changes made by "Change Order" notices. Mark the drawings with colored pencil(s). These shall be available for review by the Owner, Architect or Engineer during the entire construction stage.

C. The Record Drawings shall be updated concurrently as construction progresses, and in no case less frequently than a daily basis. They shall indicate accurate dimensions for all buried or concealed work, precise locations of all concealed pipe or duct, locations of all concealed valves, controls and devices and any deviations from the work shown on the Construction Documents. All dimensions shall include at least two dimensions to permanent structure points.

D. Record Drawings shall indicate, at a minimum, the following installed conditions:

1. Duct mains and branches, size and location, for both exterior and interior; locations of dampers, fire dampers, duct access panels, and other control devices; filters, fuel fired heaters, fan coils, condensing units, and roof-top A/C units requiring periodic maintenance or repair.
2. Mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located (i.e., traps, strainers, expansion compensators, tanks, etc.). Valve location diagrams, complete with valve tag chart. Indicate actual inverts and horizontal locations of underground piping.
3. Equipment locations (exposed and concealed), dimensioned from prominent building lines.
4. Approved substitutions, Contract Modifications, and actual equipment and materials installed.
5. Contract Modifications, actual equipment and materials installed.

E. Engage the services of a Land Surveyor or Professional Engineer registered in the state in which the project is located as specified herein to record the locations and invert elevations of underground installations.

F. If the Contractor does not keep an accurate set of Record Drawings, the pay request may be altered or delayed at the request of the Architect. Delivery of Record Documents is a condition of final acceptance. Record Drawings shall be furnished in addition to Shop Drawings.

G. The Contractor shall submit an electronic copy of the record documents in PDF format and one (1) full size set of Record Drawing prints to the Architect or Engineer for review prior to scheduling the final inspection at the completion of the work. The drawings shall have the name(s) and seal(s) of the Engineer(s) removed or blanked out and shall be clearly marked and signed on each sheet as follows:

CERTIFIED RECORD DRAWINGS

DATE:

(NAME OF GENERAL CONTRACTOR)

BY: _____

(SIGNATURE)

(NAME OF SUBCONTRACTOR)

BY: _____

(SIGNATURE)

1.17 OPERATING AND MAINTENANCE MANUALS

A. Prepare operating and maintenance manuals in accordance with Division 00 and Division 01 and, in addition to the requirements specified in those Divisions, include the following information for equipment items:

1. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.

    a. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions.
    b. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
    c. Servicing instructions and lubrication charts and schedules.

1.18 CERTIFICATIONS AND TEST REPORTS

A. Submit a detailed schedule for completion and testing of each system indicating scheduled dates for completion of system installation and outlining tests to be performed and scheduled date for each test. This detailed completion and test schedule shall be submitted at least 90 days before the projected substantial completion date.

B. Test result reporting forms shall be submitted for review no later than the date of the detailed schedule.

C. Submit 4 copies of all certifications and test reports to the Architect or Engineer for review adequately in advance of substantial completion of the Work to allow for remedial action as required to correct deficiencies discovered in equipment and systems.

D. Certifications and test reports to be submitted shall include, but not be limited to, those items outlined in Section 230200.

1.19 OPERATING AND MAINTENANCE MANUALS

A. Prepare Operations and Maintenance manuals in accordance with the requirements of Division 01 and Division 23. In addition to the requirements of other Sections, this shall include the following information for equipment items:

1. Identifying names, name tags, designations and locations for all equipment.
2. Valve tag lists with valve number, type, color coding, location and function.
3. Reviewed Shop Drawing submittals with exceptions noted compliance letter.
4. Fabrication drawings.
5. Equipment and device bulletins and data sheets clearly highlighted to show equipment installed on the project and including performance curves and data as applicable, i.e., description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and model numbers of replacement parts.
6. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions.
7. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
8. Servicing instructions and lubrication charts and schedules.
9. Equipment and motor name plate data.
10. Wiring diagrams.
11. Exploded parts views and parts lists for all equipment and devices.
12. Color coding charts for all painted equipment and conduit.
13. Location and listing of all spare parts and special keys and tools furnished to the Owner.
14. Furnish recommended lubrication schedule for all required lubrication points with listing of type and approximate amount of lubricant required.

B. Coordinate with Division 01 for Operations and Maintenance manual requirements. Unless noted otherwise, bind together in “D ring” style three-ring binders (National model no. 79-883 or equivalent). Binders shall be large enough to allow ¼” of spare capacity. Include three (3) sets with all approved Shop Drawing submittals, fabrication drawings, bulletins, maintenance instructions, operating instructions and parts exploded views and lists for each and every piece of equipment furnished under this Specification. All sections shall be typed and indexed into sections with tabbed insertable dividers, labeled for easy reference. Utilize the individual specification section numbers shown in the Mechanical Specifications as an organization guideline. Bulletins containing information about equipment that is not installed on the project shall be properly marked up or stripped and reassembled. All pertinent information required by the Owner for proper operation and maintenance of equipment supplied by Division 23 shall be clearly and legibly set forth in memoranda that shall, likewise, be bound with bulletins.

C. In addition to the bound “hard-copy” Operation and Maintenance manuals referenced above, provide an identical electronic copy in searchable PDF format, with all sections bookmarked within the file for easy reference. Provide a USB flash drive with the final manual to the Owner.

D. Operating and Maintenance Manuals shall be turned over to the Owner or Engineer for review a minimum of fourteen (14) working days prior to the beginning of the operator training period.

E. Operating and Maintenance Manuals, which the Engineer deems incomplete, poorly organized, or otherwise unacceptable, will be rejected in writing. The Contractor will subsequently be required to again turn over Operating and Maintenance Manuals, with all deficiencies corrected, until deemed acceptable by the Engineer.

1.20 OPERATOR TRAINING

A. The Contractor shall furnish the services of factory trained specialists to instruct the Owner's operating personnel. The Owner's operator training shall include a minimum of 12 hours of onsite training in three (3) shifts of four (4) hours each.

B. 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.

C. Refer to other Division 23 Sections for additional Operator Training requirements.

1.21 FINAL COMPLETION

A. At the completion of the Work, all equipment and systems shall be tested, and faulty equipment and material shall be repaired or replaced. Refer to Sections of Division 23 for additional requirements.

B. Clean and adjust all air distribution devices and replace all air filters immediately prior to Substantial Completion.

C. Touch up and/or refinish all scratched equipment and devices immediately prior to Substantial Completion.

1.22 CONTRACTOR'S GUARANTEE

A. Use of the HVAC systems to provide temporary service during construction period will not be allowed without permission from the Owner in writing; and, if granted, shall not cause the warranty period to start, except as defined below.

B. Contractor shall guarantee to keep the entire installation in repair and perfect working order for a period of one year after the date of the Substantial Completion, and shall furnish (free of additional cost to the Owner) all materials and labor necessary to comply with the above

guarantee throughout the year beginning from the date of Substantial Completion, Beneficial Occupancy by the Owner, or the Certificate of Final Payment as agreed upon by all parties.

C. This guarantee shall not include cleaning or changing filters except as required by testing, adjusting and balancing.

D. All air conditioning compressors shall have parts and labor guarantees provided by the equipment manufacturer for a period of not less than 5 years beyond the date of Substantial Completion.

E. Refer to Sections in Division 23 for additional guarantee or warranty requirements.

1.23 TRANSFER OF ELECTRONIC FILES

A. Project documents are not intended or represented to be suitable for reuse by Architect/Owner or others on extensions of this project or on any other project. Any such reuse or modification without written verification or adaptation by Engineer, as appropriate for the specific purpose intended, will be at Architect/Owner's risk and without liability or legal exposure to Engineer or its consultants from all claims, damages, losses and expense, including attorney's fees arising out of or resulting thereof.

B. Because data stored in electronic media format can deteriorate or be modified inadvertently, or otherwise, without authorization of the data's creator, the party receiving the electronic files agrees that it will perform acceptance tests or procedures within sixty (60) days of receipt, after which time the receiving party shall be deemed to have accepted the data thus transferred to be acceptable. Any errors detected within the sixty (60) day acceptance period will be corrected by the party delivering the electronic files. Engineer is not responsible for maintaining documents stored in electronic media format after acceptance by the Architect/Owner.

C. When transferring documents in electronic media format, Engineer makes no representations as to the long-term compatibility, usability or readability of documents resulting from the use of software application packages, operating systems, or computer hardware differing from those used by Engineer at the beginning of the Project.

D. Any reuse or modifications will be at the Contractor's sole risk and without liability or legal exposure to Architect, Engineer or any consultant.

E. The Texas Board of Architectural Examiners (TBAE) has stated that it is in violation of Texas law for persons other than the Architect of record to revise the Architectural drawings without the Architect's written consent.

1. It is agreed that "MEP" hard copy or computer-generated documents will not be issued to any other party except directly to the Architect/Owner. The Contract Documents are contractually copyrighted and cannot be used for any other project or purpose except as specifically indicated in AIA B-141 Standard Form of Agreement Between Architect and Owner.
2. If the client, Architect or Owner of the project requires electronic media for "record purposes," then AutoCAD/ Revit documents will be prepared by Engineer on electronic media such as removable memory devices, flash drives or CD's. These documents can

also be submitted via file transfer protocols. AutoCAD/ Revit files will be submitted with all title block references intact to permit the end user to only view and plot the drawings. Revisions will not be permitted in this configuration.

3. At the Architect/Owner's request, Engineer will assist the Contractor in the preparation of the submittals and prepare one copy of AutoCAD/ Revit files on electronic media or submit through file transfer protocols. The electronic media will be prepared with all indicia of documents ownership removed. The electronic media will be prepared in a ".rvt" or ".dwg" format to permit the end user to revise the drawings.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Provide materials and equipment manufactured by a domestic United States manufacturer and assembled in the United States for all local and Federal Government projects. These materials and equipment shall comply with "Buy American Act."

B. Access Doors: Provide access doors as required for access to equipment, valves, controls, cleanouts and other apparatus where concealed. Access doors shall have concealed hinges and screw driver cam locks.

C. All access doors located in wet areas such as restrooms, locker rooms, shower rooms, kitchen and any other wet areas shall be constructed of stainless steel.

D. Access Doors: shall be as follows:

1. Plaster Surfaces: Milcor Style K.
2. Ceramic Tile Surface: Milcor Style M.
3. Drywall Surfaces: Milcor Style DW.
4. Install doors only in locations approved by the Architect.

2.2 EQUIPMENT PADS

A. Provide 6-inch-high concrete pads for indoor floor mounted equipment. Pads shall conform to the shape of the equipment with a minimum extension of 6 inches beyond the equipment on all sides. Top and sides of pads shall be troweled to a smooth finish, equivalent to the floor. External corners shall be bullnosed to a 3/4" radius, unless shown otherwise.

PART 3 - EXECUTION

3.1 ROUGH-IN

A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected via reviewed submittals.

B. Refer to equipment specifications in Divisions 2 through 48 for additional rough-in requirements.

3.2 MECHANICAL INSTALLATIONS

A. General: Sequence, coordinate, and integrate the various elements of mechanical systems, materials, and equipment. Comply with the following requirements:

1. Coordinate mechanical systems, equipment, and materials installation with other building components.
2. Verify all dimensions by field measurements.
3. Arrange for chases, slots, and openings in other building components during progress of construction, to allow for mechanical installations.
4. Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed.
5. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the Work. Give particular attention to large equipment requiring positioning prior to closing in the building.
6. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible.
7. Coordinate connection of mechanical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.
8. Install systems, materials, and equipment to conform with architectural action markings on submittal, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the Work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, resolve conflicts and submit proposed solution to the Architect for review.
9. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished spaces.
10. Install mechanical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as possible, connect equipment for ease of disconnecting, with minimum interference with other installations. Extend grease fittings to an accessible location and label.
11. Install access doors where units are concealed behind finished surfaces. Refer to paragraph 2.1 in this section and architect for access doors specifications and location.
12. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.
13. Provide roof curbs for all roof mounted equipment. Coordinate with roof construction for pitched roof. Provide roof curbs which match the roof slope and provide a level top for equipment installation. Refer to Architectural drawings and details.
14. The equipment to be furnished under these Specifications shall be essentially the standard product of the manufacturer. Where two or more units of the same class of equipment are required, these units shall be products of a single manufacturer; however, the component parts of the system need not be the product of the same manufacturer.

15. The Architectural and Structural features of the building and the space limitations shall be considered in selection of all equipment. No equipment shall be furnished which will not suit the arrangement and space limitations indicated.
16. Lubrication: Prior to start-up, check and properly lubricate all bearings as recommended by the manufacturer.
17. Where the word "Concealed" is used in these Specifications in connection with insulation, painting, piping, ducts, etc., it shall be understood to mean hidden from sight as in chases, furred spaces or suspended ceilings. "Exposed" shall be understood to mean the opposite of concealed.
18. Identification of Mechanical Equipment:

    a. Mechanical equipment shall be identified by means of nameplates permanently attached to the equipment. Nameplates shall be engraved laminated plastic or etched metal. Submittals shall include dimensions and lettering format for approval. Attachment shall be with escutcheon pins, self-tapping screws, or machine screws.
    b. Tags shall be attached to all valves, including control valves, with nonferrous chain. Tags shall be brass and at least 1-1/2 inches in diameter. Nameplate and tag symbols shall correspond to the identification symbols on the temperature control submittal and the "as-built" drawings.

19. Provide construction filters for all air handling units, fan coil unit, VAV boxes, and all other air handling equipment during the entire construction period.
20. Provide temporary construction strains for all strainers in the hydronic systems during the initial flushing of the systems.

3.3 CUTTING AND PATCHING

A. Protection of Installed Work: During cutting and patching operations, protect adjacent installations.

B. Perform cutting, fitting, and patching of mechanical equipment and materials required to:

1. Uncover Work to provide for installation of ill-timed Work.
2. Remove and replace defective Work.
3. Remove and replace Work not conforming to requirements of the Contract Documents.
4. Remove samples of installed Work as specified for testing.
5. Install equipment and materials in existing structures.
6. Upon written instructions from the Engineer, uncover and restore Work to provide for Engineer/Owner's observation of concealed Work, without additional cost to the Owner.
7. Patch existing finished surfaces and building components using new materials matching existing materials and experienced Installers. Patch finished surfaces and building components using new materials specified for the original installation and experienced Installers; refer to the materials and methods required for the surface and building components being patched; Refer to Paragraph 1.11 I for definition of "Installer."

C. Cut, remove and legally dispose of selected mechanical equipment, components, and materials as indicated, including but not limited to removal of mechanical piping, mechanical ducts and HVAC units, and other mechanical items made obsolete by the new Work.

D. Protect the structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed.

E. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas.

3.4 WORK SEQUENCE, TIMING, COORDINATION WITH OWNER, ARCHITECT AND ENGINEER

A. The Owner will cooperate with the Contractor, however, the following provisions must be observed:

1. A meeting will be held at the project site, prior to any construction, between the Owner's Representative, the General Contractor, the Sub-Contractors and the Engineer to discuss Contractor's employee parking space, access, storage of equipment or materials, and use of the Owner's facilities or utilities. The Owner's decisions regarding such matters shall be final.
2. During the construction of this project, normal facility activities will continue in existing buildings until renovated areas are completed. Plumbing, fire protection, lighting, electrical, communications, heating, air conditioning, and ventilation systems shall be maintained in service within the occupied spaces of the existing building.
3. Contractor shall not start-up any of the HVAC equipment unless the Owner, Architect and Engineer are signed off.
4. Start-up for major HVAC equipment such as chillers, cooling towers, variable frequency drives and hot water boilers shall be performed by a factory technician. The start-up shall include a written report signed off by Contractor, Engineer and Owner.

3.5 DEMOLITION AND WORK WITHIN EXISTING BUILDINGS

A. In the preparation of these documents every effort has been made to show the approximate locations of, and connections to, the existing piping, duct, equipment and other apparatus related to this phase of the Work. However, this Contractor shall be responsible for verifying all of the above information. This Contractor shall visit the existing site to inspect the facilities and related areas. This Contractor shall inspect and verify all details and requirements of all the Contract Documents, prior to the submission of a proposal. All discrepancies between the Contract Documents and actual job-site conditions shall be resolved by the contractor, who shall produce drawings that shall be submitted to the Architect/Engineer for review. All labor and materials required to perform the work described shall be a part of this Contract.

B. All equipment and/or systems noted on the Drawings "To Remain" shall be inspected and tested on site to certify its working condition. A written report on the condition of all equipment to remain, including a copy of the test results and recommended remedial actions and costs shall be made by this Contractor to the Architect/Engineer for review.

C. All equipment and/or systems noted on the Drawings "To Be Removed" shall be removed including associated pipe and duct, pipe and duct hangers and/or line supports. Where duct or pipe is to be capped for future or end of line use, it shall be properly tagged with its function or service appropriately identified. Where existing equipment is to be removed or relocated and

has an electric motor or connection, the Electrical Contractor shall disconnect motor or connection, remove wiring to a safe point and this Contractor shall remove or relocate motor or connection along with the equipment.

D. During construction and remodeling, portions of the Project shall remain in service. Construction equipment, material, tools, extension cords, etc., shall be arranged so as to present minimum hazard or interruption to the occupants of the building. None of the construction work shall interfere with the proper operation of the existing facility or be so conducted as to cause harm or danger to persons on the premises. All fire exits, stairs or corridors required for proper access, circulation or exit shall remain clear of equipment, materials or debris. The General Contractor shall maintain barricades, other separations in corridors and other spaces where work is conducted.

E. Certain work during the demolition and construction phases may require overtime or night time shifts or temporary evacuation of the occupants. Coordinate and schedule all proposed down time with the Owner at least seventy-two (72) hours in advance in writing.

F. Any salvageable equipment as determined by the Owner, shall be delivered to the Owner, and placed in storage at the location of his choice. All other debris shall be removed from the site immediately.

G. Equipment, piping or other potential hazards to the occupants of the building shall not be left overnight outside of the designated working or construction area.

H. Make every effort to minimize damage to the existing building and the Owner's property. Repair, patch or replace as required any damage that occurs as a result of work at the site. Care shall be taken to minimize interference with the Owner's activities during construction and to keep construction disrupted areas to a minimum. Coordinate with the Owner and other trades in scheduling and performance of the work.

I. Include in the contract price all rerouting of existing pipe, duct, etc., and the reconnecting of the existing equipment as necessitated by field conditions to allow the installation of the new systems regardless of whether or not such rerouting, reconnecting or relocating is shown on the Drawings. Furnish all temporary pipe, duct, controls, etc., as required to maintain heating, cooling, and ventilation services for the existing areas with a minimum of interruption.

J. All existing pipe, duct, materials, equipment, controls and appurtenances not included in the remodel or alteration areas are to remain in place.

K. Pipe, duct, equipment and controls serving mechanical and other Owner's equipment, etc., which is to remain but is served by pipe, duct, equipment and controls that are disturbed by the remodeling work, shall be reconnected in such a manner as to leave this equipment in proper operating condition.

L. No portion of the fire protection systems shall be turned off, modified or changed in any way without the express knowledge and written permission of the Owner’s representative in order to protect systems that shall remain in service.

M. It is the intention of this Section of the Specifications to outline minimum requirements to furnish the Owner with a turn-key and operating system in cooperation with other trades with a minimum of disruption or downtime.

N. Refer to Architectural Demolition and/or Alteration plans for actual location of walls, ceilings, etc., being removed and/or remodeled.

END OF SECTION 230200

SECTION 230201 - COORDINATION DRAWINGS

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions 013100 and Supplementary Conditions apply to all Work herein.

1.2 COORDINATION DRAWINGS

A. The Contractor shall take the lead in coordinating the Mechanical, Electrical, Plumbing, Communications, Electronic Safety/Security and Fire Protection systems within the building.

B. The Contractor shall coordinate a three-dimensional (3D) model of the building which includes the Mechanical, Electrical, Plumbing, and Fire Protection systems. The Contractor will be provided with the REVIT model that was used to generate the contract documents, this file may be used as the background file. The Contractor shall replace the systems drawn with the actual shop drawing models. The Contractor is not limited to using REVIT and may use any 3D software in generating and combining the coordination model.

C. Submitting the contract drawings as coordination drawings will not be acceptable.

D. The model shall include detailed and accurate representations of all equipment to be installed based upon the reviewed equipment submittals.

E. The Contractor shall hold a 3-D coordination meeting with all sub-contractors present to review the model and discuss coordination of the installation of the building systems.

F. Upon completion of the coordination meeting, the Contractor shall submit the 3-D model and 1/4” scale drawings for review.

G. The model shall detail major elements, components, and systems in relationship with other systems, installations, and building components. Indicate locations where space is limited for installation and access and where sequencing and coordination of installations are of importance to the efficient flow of the Work, including (but not necessarily limited to) the following:

H. Indicate the proposed locations of pipe, duct, equipment, and other materials. Include the following:

1. Wall and type locations.
2. Clearances for installing and maintaining insulation.
3. Locations of light fixtures and sprinkler heads.
4. Clearances for servicing and maintaining equipment, including tube removal, filter removal, and space for equipment disassembly required for periodic maintenance.
5. Equipment connections and support details.

6. Exterior wall and foundation penetrations.
7. Routing of storm and sanitary sewer piping.
8. Fire-rated wall and floor penetrations.
9. Sizes and location of required concrete pads and bases.
10. Valve stem movement.
11. Structural floor, wall and roof opening sizes and details.

I. Indicate scheduling, sequencing, movement, and positioning of large equipment into the building during construction.

J. Prepare floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.

K. Prepare reflected ceiling plans to coordinate and integrate installations, air distribution devices, light fixtures, communication systems components, and other ceiling-mounted items.

L. Sequence of Coordination - Below is hierarchy of model elements and the sequencing by which the models will be coordinated.

1. Structural and Architectural model
2. Miscellaneous steel
3. Perform preliminary space allocation
4. Identify hard constraints (locations of access panels, lights, A/V space requirements, etc.)
5. Main and medium pressure ducts from the shaft out
6. Main graded plumbing lines and vents
7. Sprinkler mains and branches
8. Cold and hot water mains and branches
9. Lighting fixtures and plumbing fixtures
10. Smaller sized ducts and flex ducts
11. Smaller size cold water and hot water piping, flex ducts, etc.

M. The Contractor shall not install any item until the coordination has been completed and reviewed by the Construction Manager, Owner, and A/E team.

N. The Contractor shall be responsible for coordination of all items that will affect the installation of the work. This coordination shall include, but not be limited to: voltage, ampacity, capacity, electrical and piping connections, space requirements, sequence of construction, building requirements and special conditions.

O. By submitting shop drawings on the project, the Contractor is indicating that all necessary coordination has been completed and that the systems, products and equipment submitted can be installed in the building and will operate as specified and intended, in full coordination with all trades.

END OF SECTION 230201

SECTION 230300 - MECHANICAL DEMOLITION FOR REMODELING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Mechanical demolition.

B. The Drawings do not show all demolition work required. The Contractor shall make himself familiar with the required scope of work to accomplish the work required by these documents. All demolition work implied or required shall be included in the scope of this contract.

C. Utility service outages required by the new installation will be permitted but only at a time approved by the Owner. The Contractor shall allow the Owner 2 weeks in order to schedule required outages. The time allowed for outages will not be during normal working hours unless otherwise approved by the Owner. All costs of outages, including overtime charges, shall be included in the contract amount.

1.2 RELATED SECTIONS

A. Section 024000 - Demolition and Structure Moving.

1.3 WORK SEQUENCE, TIMING, COORDINATION WITH OWNER

A. The Owner will cooperate with the Contractor; however, the following provisions must be observed:

1. During the construction of this project, normal facility activities will continue in existing buildings until new buildings or renovated areas are completed. Plumbing, fire protection, lighting, electrical, communications, heating, air conditioning, and ventilation systems shall be maintained in service within the occupied spaces of the existing building.
2. A meeting will be held at the project site, prior to any construction, between the Owner's Representative, the General Contractor, the Subcontractors and Sub-subcontractors, and the Engineer to discuss Contractor's employee parking space, access, storage of equipment or materials, and use of the Owner's facilities or utilities. The Owner's decisions regarding such matters shall be final.

1.4 DEMOLITION AND WORK WITHIN EXISTING BUILDINGS

A. In the preparation of these documents every effort has been made to show the approximate locations of, and connections to the existing piping, duct, equipment and other apparatus related to this phase of the Work. However, this Contractor shall be responsible for verifying all of the above information. This Contractor shall visit the existing site to inspect the facilities and related areas. This Contractor shall inspect and verify all details and requirements of all the

Contract Documents, prior to the submission of a proposal. All discrepancies between the Contract Documents and actual job-site conditions shall be resolved by the contractor, who shall produce drawings which shall be submitted to the Architect/Engineer for review. All labor and materials required to perform the work described shall be a part of this Contract.

B. All equipment and/or systems noted on the Drawings "To Remain" shall be inspected and tested on site to certify its working condition. A written report on the condition of all equipment to remain, including a copy of the test results and recommended remedial actions and costs shall be made by this Contractor to the Architect/Engineer for review.

C. All equipment and/or systems noted on the Drawings "To Be Removed" should be removed including, associated pipe and duct, pipe and duct hangers and/or line supports. Where duct or pipe is to be capped for future or end of line use, it shall be properly tagged with its function or service appropriately identified. Where existing equipment is to be removed or relocated and has an electric motor or connection, the Electrical Contractor shall disconnect motor or connection, remove wiring to a safe point and this Contractor shall remove or relocate motor or connection along with the equipment.

D. During construction and remodeling, portions of the Project shall remain in service. Construction equipment, material, tools, extension cords, etc., shall be arranged so as to present minimum hazard or interruption to the occupants of the building. None of the construction work shall interfere with the proper operation of the existing facility or be so conducted as to cause harm or danger to persons on the premises. All fire exits, stairs or corridors required for proper access, circulation or exit shall remain clear of equipment, materials or debris. The General Contractor shall maintain barricades, other separations in corridors and other spaces where work is conducted.

E. Certain work during the demolition and construction phases may require overtime or night time shifts or temporary evacuation of the occupants. Coordinate and schedule all proposed down time with the Owner at least seventy-two (72) hours in advance in writing.

F. Any salvageable equipment as determined by the Owner, shall be delivered to the Owner, and placed in storage at the location of his choice. All other debris shall be removed from the site immediately.

G. Equipment, piping or other potential hazards to the occupants of the building shall not be left overnight outside of the designated working or construction area.

H. Make every effort to minimize damage to the existing building and the Owner's property. Repair, patch or replace as required any damage which occurs as a result of work at the site. Care shall be taken to minimize interference with the Owner's activities during construction and to keep construction disrupted areas to a minimum. Coordinate with the Owner and other trades in scheduling and performance of the work.

I. Include in the contract price all rerouting of existing pipe, duct, etc., and the reconnecting of the existing equipment as necessitated by field conditions to allow the installation of the new systems regardless of whether or not such rerouting, reconnecting or relocating is shown on the drawings. Furnish all temporary pipe, duct, controls, etc., as required to maintain heating, cooling, and ventilation services for the existing areas with a minimum of interruption.

J. All existing pipe, duct, materials, equipment, controls and appurtenances not included in the remodel or alteration areas are to remain in place.

K. Pipe, duct, equipment and controls serving mechanical and other Owner's equipment, etc., which is to remain but which is served by pipe, duct, equipment and controls that are disturbed by the remodeling work, shall be reconnected in such a manner as to leave this equipment in proper operating condition.

L. No portion of the fire protection systems shall be turned off, modified or changed in any way without the express knowledge and written permission of the Owner's representative in order to protect systems that shall remain in service.

M. It is the intention of this Section of the Specifications to outline minimum requirements to furnish the Owner with a turn-key and operating system in cooperation with other trades with a minimum of disruption or downtime.

N. Refer to Architectural Demolition and/or Alteration plans for actual location of walls, ceilings, etc., being removed and/or remodeled.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. Materials and equipment for patching and extending work: As specified in individual Sections.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Field verifies measurements, and piping arrangements are as shown on Drawings.

B. Verify that abandoned piping and equipment serve only abandoned facilities.

C. Demolition Drawings are based on casual field observation and existing Record Documents. Report discrepancies to Architect and Engineer before disturbing existing installation.

D. Beginning of demolition means that the contractor accepts existing conditions.

3.2 PREPARATION

A. Disconnect mechanical systems in walls, floors, and ceilings scheduled for removal.

B. Coordinate utility service outages with Utility Company.

C. Provide temporary connections, if required, to maintain existing systems in service during construction. When work must be performed on energized equipment, use personnel experienced in such operations.

D. Existing Service: 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 24 hours before partially or completely disabling system. Minimize outage duration. Make temporary connections to maintain service in areas adjacent to work area.

E. Existing Fire Alarm System: Maintain existing system in service until new system is accepted. Disable system only to make switchovers and connections. Notify Owner and local fire service at least 24 hours before partially or completely disabling system. Minimize outage duration. Make temporary connections to maintain service in areas adjacent to work area.

3.3 DEMOLITION AND EXTENSION OF EXISTING MECHANICAL WORK

A. Demolish and extend existing mechanical work under provisions of Division 02 and this Section.

B. Remove, relocate, and extend existing systems to accommodate new construction.

C. Remove abandoned piping to source of supply.

D. Remove exposed abandoned piping systems, including abandoned systems above accessible ceiling finishes. Cut systems flush with walls and floors, and patch surfaces.

E. Repair adjacent construction and finishes damaged during demolition and extension work.

F. Maintain access to existing systems which remain active. Modify installation or provide access doors as appropriate.

G. Extend existing systems using materials and methods compatible with existing systems, or as specified.

3.4 CLEANING AND REPAIR

A. Clean and repair existing materials and equipment which remain or are to be reused.

3.5 INSTALLATION

A. Install relocated materials and equipment under the provisions of Division 02.

3.6 REMOVAL OF MATERIALS

A. The Contractor shall modify, remove, and/or relocate all materials and items so indicated on the Drawings or required by the installation of new facilities. All removals and/or dismantling shall be conducted in a manner as to produce maximum salvage. Salvage materials shall remain the

property of the Owner and shall be delivered to such destination as directed by the Owner. Materials and/or items scheduled for relocation and which are damaged during dismantling or reassembly operations shall be repaired and restored to good operating condition. The Contractor may, at his discretion and upon the approval of the Owner, substitute new materials and/or items of like design and quality in lieu of materials and/or items to be relocated.

B. All items which are to be relocated shall be carefully removed in reverse to original assembly or placement and protected until relocated. The contractor shall clean and repair and provide all new materials, fittings, and appurtenances required to complete the relocations and to restore to good operative order. All relocations shall be performed by workmen skilled in the work and in accordance with standard practice of the trades involved.

C. When items scheduled for relocation are found to be in damaged condition before work has been started on dismantling, the Contractor shall call the attention of the Owner to such items and receive further instructions before removal. Items damaged in repositioning operations are the Contractor's responsibility and shall be repaired or replaced by the Contractor as approved by the Owner, at no additional cost to the Owner.

D. Service lines and wiring to items to be removed, salvaged, or relocated shall be removed to points indicated on the Drawings, specified, or acceptable to the Owner. Service lines and wiring not scheduled for reuse shall be removed to the points at which reuse is to be continued or service is to remain. Such services shall be sealed, capped, or otherwise tied-off or disconnected in a safe manner acceptable to the Owner. All disconnections or connections into the existing facilities shall be done in such a manner as to result in minimum interruption of services to adjacent occupied areas. Services to existing areas or facilities which must remain in operation during the construction period shall not be interrupted without prior specific approval of the Owner as hereinbefore specified.

E. Certain work during the demolition and construction phases may require overtime or nighttime shifts or temporary evacuation of the occupants. Coordinate and schedule all proposed down time with the Owner's Representative at least 72 hours in advance in writing.

F. Make every effort to minimize damage to the existing building and the Owner's property. Repair, patch, or replace as required any damage which occurs as a result of work at the site. Care shall be taken to minimize interference with the Owner's activities during construction. Cooperate with the Owner and other trades in scheduling and performance of the work.

G. See Paragraph I on page 230200 – 18

H. The Contractor shall be responsible for loss or damage to the existing facilities caused by him and his workmen and shall be responsible for repairing such loss or damage. The Contractor shall send proper notices, make necessary arrangements, and perform other services required for the care, protection and in-service maintenance of all electrical services for the new and existing facilities. The Contractor shall erect temporary barricades, with necessary safety devices, as required to protect personnel from injury, removing all such temporary protection upon completion of the work.

I. Where existing construction is removed to provide working and extension access to existing utilities, Contractor shall remove doors, piping, conduit, outlet boxes, wiring, light fixtures, air

conditioning ductwork and equipment, etc., to provide this access and shall reinstall same upon completion of work in the areas affected.

J. Where partitions, walls, floors, or ceilings of existing construction are being removed, all contractors shall remove and reinstall in locations approved by the Architect all devices required for the operation of the various systems installed in the existing construction.

END OF SECTION 230300

SECTION 230513 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

B. Section 230200 - Basic Materials and Methods for HVAC shall be included as a part of this Section as though written in full in this document.

1.2 SCOPE

A. Scope of the Work shall include the furnishing and complete installation of the equipment covered by this Section, with all auxiliaries, ready for owner's use.

B. WORK SPECIFIED ELSEWHERE:

1. Painting
2. Automatic temperature controls
3. Power control wiring to motors and equipment

1.3 WARRANTY

A. Warrant the Work specified herein for one year and motors for five years beginning on the date of substantial completion.

1.4 REFERENCE STANDARDS

A. IEEE 112 - IEEE Standard Test Procedure for Polyphase Induction Motors and Generators; 2017.

B. NEMA MG 1 - Motors and Generators; 2021.

1.5 SUBMITTALS

A. SHOP DRAWINGS: Indicate size material, and finish. Show locations and installation procedures. Include details of joints, attachments, and clearances.

B. PRODUCT DATA: Submit schedules, charts, literature, and illustrations to indicate the performance, fabrication procedures variations, and accessories.

C. MOTOR NAMEPLATE INFORMATION: Manufacturer’s name, address, utility and operating data.

D. Refer to Division One for additional information.

1.6 DELIVERY AND STORAGE

A. DELIVERY: Deliver clearly labeled, undamaged materials in the manufacturers' unopened containers.

B. TIME 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.

PART 2 - PRODUCTS

2.1 ELECTRIC MOTORS

A. APPROVED MANUFACTURERS: Provide motors by a single manufacturer as much as possible.

1. Baldor
2. Marathon
3. Siemens-Allis
4. General Electric
5. U.S. Motor

B. TEMPERATURE RATING: Provide insulation as follows:

1. CLASS B: 40 degrees C maximum.
2. CLASS F:

a. Between 40 degrees C and 65 degrees C maximum.
b. Totally enclosed motors.

C. STARTING CAPABILITY: As required for service indicated five starts minimum per hour.

D. PHASES AND CURRENT: Verify electrical service compatibility with motors to be used.

1. UP TO 3/4 HP: Provide electronically commutated brushless DC single phase motors with built-in inverter and microprocessor-based control.
2. 1 HP AND LARGER: Provide squirrel-cage AC induction polyphase motors.
3. Name plate voltage shall be the same as the circuit's nominal voltage, serving the motor.

E. SERVICE FACTOR: 1.15 for polyphase; 1.35 for single phase.

F. FRAMES: U-frames 1.5 hp. and larger.

G. BEARINGS: Provide sealed re-greaseable ball bearings; with top mounted Zerk lubrication fittings and bottom side drains minimum average life 100,000 hours typically, and others as follows:

1. Design for thrust where applicable.
2. PERMANENTLY SEALED: Where not accessible for greasing.
3. SLEEVE-TYPE WITH OIL CUPS: Light duty fractional hp. motors or polyphase requiring minimum noise level.

H. ENCLOSURE TYPE: Provide enclosures as follows, except where otherwise indicated:

1. CONCEALED INDOOR: ODP (Open Drip Proof).
2. EXPOSED INDOOR: Guard Protected.
3. OUTDOOR TYPICAL: Type II. TEFC.
4. OUTDOOR WEATHER PROTECTED: Type I. WPI.
5. EXPLOSION PROOF, XP: For use in hazardous locations.

I. OVERLOAD PROTECTION: Built-in sensing device for stopping motor in all phase legs and signaling where indicated for fractional horse power motors.

J. NOISE RATING: “Quiet" except where otherwise indicated.

K. All motors that are to be operated by a variable frequency drive shall be inverter duty rated motors.

L. All motors operated by variable frequency drive shall be equipped with a maintenance free, conductive microfiber, shaft grounding ring with a minimum of two rows of circumferential microfibers to discharge electrical shaft currents within the motor and/or its bearings.

M. EFFICIENCY: Minimum full load efficiency listed in the following table, when tested in accordance with IEEE 112, Method B, including stray load loss measure.

N.

NEMA MG 1 Efficiency - 1800 RPM Synchronous Speed		
Motor horsepower	Index Letter	Minimum Efficiency
3 - 5	G	89.5
7.5	G	91.0
10	F	91.7
15 - 20	E	93.0
25 - 30	E	93.6

2.2 MOTOR CONTROLLERS (STARTERS)

A. All motor controllers (for equipment furnished under Division 23) shall be furnished under Division 23 and installed under Division 26 unless otherwise noted on the plans.

1. Starters shall be provided for 3 phase motors 1 horsepower and greater.

B. Motor starters shall be furnished as follows.

1. GENERAL: Motor starters shall be Square D Company Class 8536 across-the-line magnetic type, full-voltage, non-reversing (FAVOR) starter. All starters shall be constructed and tested in accordance with the latest NEMA standards, sizes and horsepower. ICE sizes are not acceptable. Starters shall be mounted in a general purpose dead front, painted steel enclosure and surface-mounted. Provide size and number of poles as shown and required by equipment served. Provide two speed, two winding or two speed, single winding motor starter as required for two speed motors.
2. CONTACTS: Magnetic starter contacts shall be double break solid silver alloy. All contacts shall be replaceable without removing power wiring or removing starter from panel. The starter shall have straight-through wiring.
3. OPERATING COILS: Operating coils shall be 120 volts and shall be of molded construction. When the coil fails, the starter shall open and shall not lock in the closed position.
4. OVERLOAD RELAYS: Provide manual reset, trip-free Class 20 overload relays in each phase conductor in of all starters. Overload relays shall be melting alloy type with visual trip indication. All 3 phase and single phase starters shall have one overload relay in each underground conductor. Relay shall not be field adjustable from manual to automatic reset. Provide 6 overload relays for two speed motor starters.
5. PILOT LIGHTS: Provide a red running pilot light for all motor starters. Pilot lights shall be mounted in the starter enclosure cover. Pilot lights shall be operated from an interlock on the motor starter and shall not be wired across the operating coil.
6. CONTROLS: Provide starters with HAND-OFF-AUTOMATIC switches. Coordinate additional motor starter controls with the requirements of Division 23. Motor starter controls shall be mounted in the starter enclosure cover.
7. CONTROL POWER TRANSFORMER: Provide a single-phase 480 volt control power transformer with each starter for 120 volt control power. Connect the primary side to the line side of the motor starter. The primary side shall be protected by a fuse for each conductor. The secondary side shall have one leg fused and one leg grounded. Arrange transformer terminals so that wiring to terminals will not be located above the transformer.
8. AUXILIARY CONTACTS: Each starter shall have one normally open and one normally closed convertible auxiliary contact in addition to the number of contacts required for the "holding interlock", remote monitoring, and control wiring. In addition, it shall be possible to field-install three more additional auxiliary contacts without removing existing wiring or removing the starter from its enclosure.
9. UNIT WIRING: Unit shall be completely pre-wired to terminals to eliminate any interior field wiring except for line and load power wiring and HVAC control wiring.
10. ENCLOSURES: All motor starter enclosures shall be NEMA 1, general purpose enclosures or NEMA-3R if mounted exposed to high moisture conditions. Provide NEMA 4X when located by cooling towers.
11. POWER MONITOR: Provide a square "D" 8430 MPS phase failure and under-voltage relay, base and wiring required for starters serving all 3 phase motors. Set the under-voltage setting according to minimum voltage required for the motor to operate within its range.

C. APPROVED MANUFACTURERS: Controller numbers are based on first named manufacturer. Provide one of the following manufacturers.

1. Siemens.
2. Square D.

3. General Electric.
4. Eaton.

2.3 COMBINATION MOTOR STARTERS

A. GENERAL: Combination motor starters shall consist of a magnetic starter and a fusible or non-fusible disconnect switch in a dead front, painted steel NEMA 1 enclosure unless otherwise noted and shall be surface-mounted. Size and number of poles shall as shown and required by equipment served. Combination motor starters shall be as specified for motor starters in Paragraph 2.02-B, except as modified herein.

B. DISCONNECT SWITCH: Disconnect switches shall be as specified in Section 262816.

C. APPROVED MANUFACTURERS: Controller numbers are based on first named manufacturer. Provide one of the following manufacturers.

1. Siemens.
2. Square D.
3. General Electric.

PART 3 - EXECUTION

3.1 INSTALLATION

A. All equipment shall be installed in accordance with the manufacturers' recommendations and printed installation instructions.

B. All items required for a complete and proper installation are not necessarily indicated on the plans or in the specifications. Contractors' price shall include all items required as per manufacturers' requirements.

C. Install in a professional manner. Any part or parts not meeting this requirement shall be replaced or rebuilt without extra expense to Owner.

D. Install rotating equipment in static and dynamic balance.

E. Provide foundations, supports, and isolators properly adjusted to allow minimum vibration transmission within the building.

F. Correct objectionable noise or vibration transmission in order to operate equipment satisfactorily as determined by the Engineer.

END OF SECTION 230513

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SECTION 230516 - EXPANSION FITTINGS AND LOOPS FOR HVAC PIPING

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

B. Section 230200 - Basic Materials and Methods for HVAC shall be included as a part of this Section as though written in full in this document.

1.2 WORK INCLUDED

A. Flexible pipe connections.

B. Expansion joints and compensators

C. Pipe loops, offsets, and swing joints.

1.3 RELATED WORK

A. Section 230529 - Hangers and Supports for Piping and Equipment - HVAC

B. Section 232113 - Above Ground Hydronic Piping

C. Section 232213 - Steam and Condensate Heating Piping

D. Section 232300 - Refrigerant Piping

1.4 PERFORMANCE REQUIREMENTS

A. Provide structural work and equipment required to control expansion and contraction of piping. Verify that anchors, guides, and expansion joints provided, adequately protect system.

B. Expansion Calculations:

1. Installation Temperature: 50 degrees F (10 degrees C)
2. Hot Water Heating: 210 degrees F (99 degrees C)
3. Domestic Hot Water: 140 degrees F (60 degrees C)
4. Steam: 380 degrees F (193 degrees C)
5. Steam Condensate: 212 degrees F (100 degrees C)
6. Safety Factor: 30 percent.

C. Pipe sizes indicated are to establish a minimum quality of compensator. Refer to manufacturer's literature for model series for different pipe sizes.

1.5 SUBMITTALS

A. Submit shop drawings under provisions of Division One.

B. Product Data:

1. Flexible Pipe Connectors: Indicate maximum temperature and pressure rating, face-to-face length, live length, hose wall thickness, hose convolutions per foot (meter) and per assembly, fundamental frequency of assembly, braid structure, and total number of wires in braid.
2. Expansion Joints: Indicate maximum temperature and pressure rating, and maximum expansion compensation.

C. Design Data: Indicate selection calculations.

D. Manufacturer`s Installation Instructions: Indicate special procedures, and external controls.

1.6 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Division One.

B. Record actual locations of flexible pipe connectors, expansion joints, anchors, and guides.

1.7 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Division One.

B. Maintenance Data: Include adjustment instructions.

1.8 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the products specified in this section with minimum five years' documented experience.

B. Design expansion compensation system under direct supervision of a Professional Engineer experienced in design of this work and licensed in the state where the project is located.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products under provisions of Division One.

B. Accept expansion joints on site in factory packing with shipping bars and positioning devices intact. Inspect for damage.

C. Protect equipment from exposure by leaving factory coverings, pipe end protection, and packaging in place until installation.

1.10 WARRANTY

A. Provide five year warranty under provisions of Division One.

B. Warranty: Include coverage for leak free performance of packed expansion joints.

1.11 EXTRA MATERIALS

A. Furnish under provisions of Division One.

PART 2 - PRODUCTS

2.1 FLEXIBLE PIPE CONNECTORS

A. Steel Piping (Based on 2" Pipe):

1. Manufacturers:

a. VMC Group, Model SS-PM or SS-FP
b. Mercer Rubber Company, Model BSS-EM (Mason Industries)

2. Inner Hose: Type 321, stainless steel, corrugated metal.
3. Exterior Sleeve: Type 304, single braided stainless steel.
4. Pressure Rating: 350 psig WOG and 70 degrees F. For 4 inch pipe - 200 psig WOG and 70 degrees F.
5. Joint: Schedule 40 steel, threaded with male nipple and hex boss each end and union. Flanged joints for pipe sizes 2½ inch and larger.
6. Size: Use pipe sized units.
7. Maximum offset: 1/2 inch on each side of installed center line.
8. Application: Air handling unit cooling and heating coils.

B. Copper Piping (Based on 2" Pipe):

1. Manufacturers:

a. VMC Group, Model BR-FS
b. Mercer Rubber Company, Model BFF (Mason Industries)

2. Inner Hose: Corrugated Bronze
3. Exterior Sleeve: Braided bronze.
4. Pressure Rating: 250 psig WOG and 70 degrees F.
5. Joint: Threaded with male nipple and hex boss each end with union. Flanged joints for pipe sizes 2½ inch and larger.
6. Size: Use pipe sized units.

7. Maximum offset: 1/2 inch on each side of installed center line.
8. Application: Air handling unit cooling and heating coils.

2.2 EXPANSION JOINTS

A. Bellows Type (Based on 4" Pipe):

1. Manufacturers:

a. VMC Group, Model EB
b. Mercer Rubber Company, Model 803 or 805 (Mason Industries)

2. Body: Monel wire reinforced molded TFE teflon bellows, multiple arch.
3. Pressure Rating: 70 psig WSP and 250 degrees F (66 degrees C).
4. Maximum Compression: 1 inch.
5. Maximum Extension: 1 inch.
6. Maximum Offset: 1/2 inch.
7. Joint: ASA standard ductile iron flanges, integral molded gasket.
8. Size: Use pipe sized units.
9. Accessories: Control rod limit bolts.
10. Application: Steel piping 8 inch and under.

2.3 ACCESSORIES

A. Pipe Alignment Guides to Direct Axial Movement:

1. Manufacturers:

a. Metraflex, Style IV

2. Two piece welded steel with shop paint, and bolted to fit standard pipe, frame with four mounting holes, clearance for minimum 1 inch thick insulation, minimum 3 inch travel.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer`s instructions.

B. Construct spool pieces to exact size of flexible connection for future insertion.

C. Install flexible pipe connectors on pipes connected to equipment supported by vibration isolation. Provided line size flexible connectors.

D. Install flexible connectors at right angles to displacement. Install one end immediately adjacent to isolated equipment and anchor other end. Install in horizontal plane unless indicated otherwise.

E. Provide miscellaneous metals to rigidly anchor pipe to building structure. Provide pipe guides so that movement takes place along axis of pipe only. Erect piping such that strain and weight is not on cast connections or apparatus.

F. Provide support and equipment required to control expansion and contraction of piping. Provide loops, pipe offsets, and swing joints, or expansion joints where required.

3.2 MANUFACTURER`S FIELD SERVICES

A. Prepare and start systems under provisions of Division One.

B. Provide inspection services by flexible pipe manufacturer`s representative for final installing and certify installation is in accordance with manufacturer`s recommendations and connectors are performing satisfactorily.

END OF SECTION 230516

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SECTION 230526 - VARIABLE FREQUENCY MOTOR SPEED CONTROL FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. Section 1.01 A in Section 230513

B. Section 1.01 B in Section 230513

C. Furnish and install a complete adjustable frequency motor speed control for the following items:

1. Variable volume air handling units.
2. Variable volume ventilation fans.

1.2 RELATED SECTIONS

A. Section 230200 - Basic Materials and Methods for HVAC

B. Section 230513 - Common Motor Requirements for HVAC Equipment

C. Section 230548 - Vibration and Seismic Controls for HVAC Piping and Equipment

D. Section 230593 - Testing, Adjusting, And Balancing

E. Section 230963 - Energy Management and Control System (EMCS)

F. Section 232123 - Hydronic Pumps

G. Section 237313 - Modular Indoor Central Station Air Handling Units

1.3 REFERENCES

A. ASHRAE (HVACA) - ASHRAE Handbook - HVAC Applications; Most Recent Edition Cited by Referring Code or Reference Standard.

B. ISO 9001 - Quality Management Systems — Requirements; 2015, with Amendment (2024).

C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

D. UL 508 - Industrial Control Equipment; Current Edition, Including All Revisions.

E. UL 508A - Industrial Control Panels; Current Edition, Including All Revisions.

1.4 SUBMITTALS

A. Submit shop drawings and product data under provisions of Division One.

B. Certified noise data shall be submitted by drive manufacturer. Noise generated by variable frequency motor speed control drive shall not exceed preferred "RC" as listed in 2019 ASHRAE (HVACA), Chapter 49 Noise and Vibration Control, Table 2 Criteria for Acceptable HVAC Noise in Unoccupied Rooms.

1.5 WARRANTY

A. Warranty shall be 36 months from the date of certified start-up, not to exceed 40 months from the date of shipment. The warranty shall include all parts, labor, travel time and expenses. There shall be 365/24 support available via a toll-free phone number.

1.6 DELIVERY, STORAGE AND HANDLING

A. Equipment shall be stored and handled per manufacturer's instructions.

1.7 OPERATIONS PERSONNEL TRAINING

A. Provide a training session for the owner's operations personnel. Training session shall be performed by a qualified person who is knowledgeable in the subject system/equipment. Submit a training agenda two (2) weeks prior to the proposed training session for review and approval. Training session shall include at the minimum:

1. Purpose of equipment.
2. Principle of how the equipment works.
3. Important parts and assemblies.
4. How the equipment achieves its purpose and necessary operating conditions.
5. Most likely failure modes, causes and corrections.
6. On site demonstration.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. ABB

B. Yaskawa/Magnetek

C. Danfoss

2.2 ADJUSTABLE FREQUENCY INVERTER

A. The AFD package as specified herein shall be enclosed in a NEMA 12 enclosure for interior applications, a NEMA 3R enclosure for exterior locations and a NEMA 4X enclosure where located in a cooling tower yard or within 20 feet from cooling tower. All enclosures shall be completely assembled and tested by the manufacturer in an ISO 9001 facility. The AFD shall operate from a line of +30% over nominal and the under-voltage trip level shall be 35% under the nominal voltage as a minimum.

B. The fused input shall utilize fast acting current limiting type per manufacturer recommendations.

C. The variable frequency power and logic unit shall be completely solid state. The unit shall transform 480 Volt or 208 Volt (as indicated on plans), 3 phase, 60 hertz input power into frequency and voltage controlled, 3 phase output power suitable to provide positive speed and torque control to the fan motor. The speed control shall be step-less throughout the speed range under variable torque load on a continuous basis. The adjustable frequency control shall be of a pulse width modulated type utilizing a full wave diode bridge rectifier; and shall have a power factor of 0.95 or better at all motor loads.

D. All AFD's shall have the same customer interface, including a backlit LCD two-line digital display, and keypad, regardless of horsepower rating. The keypad is to be used for local control, for setting all parameters, and for stepping through the displays and menus. The keypad shall be removable, capable of remote mounting, and shall have its own non-volatile memory. The keypad shall allow for uploading and downloading of parameter settings as an aid for the start-up of multiple AFD's. The keypad shall include Hand-Off-Auto membrane selections. When in "Hand," the AFD will be started, and the speed will be controlled from the up/down arrows. When in "Off," the AFD will be stopped. When in "Auto," the AFD will start via an external contact closure and the AFD speed will be controlled via an external speed reference.

E. The adjustable frequency inverter shall conduct no radio frequency interference (RFI) back to the input power line.

F. The AFD shall have an integral 5% impedance line reactor to reduce the harmonics to the power line and to add protection from AC line transients. The inverter/reactor shall be a single wiring point.

2.3 SELF PROTECTION

A. The following features for self-protection shall be included:

1. The overload rating of the drive shall be 110% of its normal duty current rating for 1 minute every 10 minutes. The minimum FLA rating shall meet or exceed the values in the NFPA 70 - Table 430-150 for 4-pole motors.
2. Limit the output current in under 50 microseconds due to phase to phase short circuits or severe overload conditions.
3. Protect the inverter due to non-momentary power or phase loss. The undervoltage trip shall activate automatically when the line voltage drops 15% below rated input voltage.

4. Protect the inverter due to voltage levels in excess of its rating. The overvoltage trip shall activate automatically when the DC bus in the controller exceeds 1000 VDC.
5. Protect the inverter from elevated temperatures in excess of its rating. An indicating light that begins flashing within 10 degrees C of the trip shall be provided to alert the operator to the increasing temperature condition. When the over temperature trip point is reached, this light shall be continuously illuminated.
6. The inverter shall be equipped such that a trip condition resulting from overcurrent, undervoltage, overvoltage or overtemperature shall be automatically reset, and the inverter shall be automatically reset, and the inverter shall automatically restart upon removal, or correction of the faulty condition.
7. Status lights for indication of conditions described above shall be provided. An SPDT contact for remote indication shall be provided. Additionally, status lights to show power on, zero speed, and drive enabled shall be provided. All status lights shall be self-contained in the front panel of the unit and shall be duplicated for ease of troubleshooting on the inside of the unit.
8. Current and voltage signals shall be isolated from logic circuitry.
9. Drive logic shall be microprocessor based.
10. In the event of a sustained power loss, the control shall shut down safely without component failure. Upon return of power, the system shall automatically return to normal operation if the start is in the “On” condition.
11. In the event of a momentary loss of power, the control shall be shut down safely without component failure. Upon return of power, the system shall automatically return to normal operation (if the start is in the “On” position) being able to restart into a rotating motor regaining positive speed control without shutdown or component failure.
12. In the event of a phase to phase short circuit, the control shall shut down safely without component failure.
13. In the event that an input power contactor is opened or closed while the control is activated, no damage shall result.
14. To facilitate startup and troubleshooting, the control shall operate without a motor or any other equipment connected to the inverter output.

2.4 ELECTRICAL CONSTANT SPEED BYPASS

A. Provide all components and circuitry necessary to provide manual full 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. Fast-acting semi-conductor with a fuse block shall be provided to isolate the drive for service. Bypass designs that have no such fuses must have a lockable disconnect that isolates the drive while running in bypass mode. The contactor device shall be NEC approved. A common start/stop signal shall be used for both the variable frequency drive mode and bypass mode. Manual bypass shall contain the following:

1. Two contactors mechanically interlocked via a three position through the door selector switch or keypad to provide the following controls:

    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 electronic overload.
    c. “Off” mode disconnects motor from all input power.

d. A molded case circuit breaker with door interlocked handle (lock out type) that interrupts input power to both the bypass circuitry and the drive.
e. Customer Interlock Terminal Strip - provide a separate terminal strip for connection of freeze, fire, smoke contacts, and external start command. All external safety interlocks shall remain fully functional whether the system is Hand, Auto, or Bypass mode. The remote start/stop contact shall operate in AFD and bypass modes.
f. An electronic overload selectable for class 20 or 30 shall provide protection of the motor in Bypass mode.

2. The following indicating lights (LED type) shall be provided. A test mode or push to test feature shall be provided.

a. Power on
b. External fault
c. Drive mode selected
d. Bypass mode selected
e. Drive running
f. Bypass running
g. Drive fault
h. Bypass fault
i. Bypass-H-O-A mode
j. Automatic transfer to bypass selected

3. The following relay (form C) outputs from the bypass shall be provided:

a. System started
b. System running
c. Bypass override enabled
d. Drive fault
e. Bypass fault (motor overload or underload (broken belt))
f. Bypass H-O-A position

4. The AFD shall include a “run permissive circuit” that will provide a normally open contact any time a run command is provided (local or remote start command in AFD or bypass mode). The AFD system (AFD or bypass) shall not operate the motor until it receives a dry contact closure from a damper or valve end-switch). When the AFD systems safety interlock (fire detector, freezestat, high static pressure switch, etc.) opens, the motor shall coast to a stop and the run permissive contact shall open, closing the damper or valve.
5. There shall be an internal switch to select manual or automatic bypass.
6. There shall be an adjustable current sensing circuit for the bypass to provide loss of load indication when in the bypass mode.
7. The bypass mode must include an undervoltage and phase loss relay to protect the motor from single phase power and undervoltage conditions.

a. Bypass shall be UL listed.
b. Bypass shall carry a UL 508 label.

2.5 FEATURES AND SPECIFICATIONS

A. Provide all drives and bypasses with an integral disconnect switch. The disconnect shall be door interlocked and lockable. All disconnect configurations shall be UL Listed by the drive manufacturer as a complete assembly and include a UL 508A label.

B. Output frequency shall neither vary with load nor with any input frequency variations. Output frequency shall not vary within +/-10% input voltage changes. Output frequency shall not vary with temperature changes within the ambient specification.

C. No auxiliary equipment shall be required. The output frequency shall be adjusted in proportion to 4-20 mA signal.

D. A 0 to 10 Volt DC signal shall be provided for remote indication. This 0 to 10 Volt DC signal shall vary in direct proportion to the controller speed.

E. The controller shall be started or stopped by a contact closure or through serial communications.

F. A single pole, double throw contact shall be provided for remote indication. Contact will change state when any trip condition has occurred. (contact rated for 12-250 VAC-2 AMPS).

G. A second single pole, double throw contact shall be provided for remote indication. Contact will state when the VFD receives a run command (contact rated for 12-250 VAC-24 AMPS).

H. PID Setpoint controller shall be standard in the drive, allowing a pressure or flow signal to be connected to the AFD, using the microprocessor in the AFD for the closed loop control. The AFD shall have 250 ma of 24 VDC auxiliary power and be capable of loop powering a transmitter supplied by others. The PID setpoint shall be adjustable from the AFD keypad, analog inputs, or over the communications bus.

I. Unit to operate from a 4 to 20 mA input signal and shall have hand-off-auto switch and door mounted potentiometer controls for manual speed selection.

J. Acceleration and deceleration times shall be adjustable from 30 to 300 seconds.

K. The drive shall have the ability to invert the speed signal input, as well as having offset and gain controls for speed signal conditioning.

L. Minimum and maximum speeds shall be adjustable in automatic and manual modes.

M. Hazard inputs shall be provided, capable of up to two inputs (fire, freeze). These shall each be capable of safely shutting down the inverter and illuminating a front panel hazard light depicting that a hazard condition turned the inverter off.

N. The inverter shall be a starter, containing a door interlocked input disconnect switch and manual reset motor electronic overloads, with accessible reset on front door, when a bypass is not specified.

O. Solid state ground fault interrupt circuit.

P. The LED display shall monitor and display four parameters on a single display (i.e. frequency command, output frequency, output current, and torque).

Q. A N.O. auxiliary run-time contact shall be provided for control signaling to auxiliary equipment. Contact shall close when the pump is brought on line and open when the pump is taken off line. Contact shall be rated 20 amps at 120 volts.

R. Inverter shall be UL listed.

S. Certified factory start-up shall be provided for each drive by a factory authorized service center. A certified start-up form shall be filled out for each drive with a copy provided to the Owner, and a copy kept on file at the manufacturer.

T. Factory trained application engineering and service personnel that are thoroughly familiar with the AFD products offered shall be locally available at both the specifying and installation locations. A 24/365 technical support line shall be available on a toll-free line.

U. A computer based training CD or 8-hour professionally generated video shall be provided to the Owner at the time of Substantial Completion. The training shall include installation, programming and operation of the AFD, bypass and serial communication.

V. Provide a motor end surge control voltage suppressive filter if the VFD manufacturer cannot limit their voltage surges to under 1000 volt at 100 feet.

W. Provide a motor acoustic noise reduction filter capable of approximately 12 dBA attenuation, if the VFD raises the dBa level above 3 dBa at a distance of 3 feet from the motor.

X. Provide each unit with a 3% reactor which is mounted on both the positive and negative DC bus. The reactor shall be a single wiring point and mounted internally to the drive.

Y. Adjustable frequency inverters shall have native BACnet protocol for integration with EMCS. If the inverter does not have native BACnet protocol, a BACnet interface card shall be provided.

PART 3 - EXECUTION

3.1 InstallATION

A. Install drives in accordance with manufacturer’s published installation instructions. Installation location shall provide all required clearances around each drive.

B. All wiring shall be installed in accordance with the manufacturer’s installation instructions.

C. Variable frequency speed drives shall be located so that wiring to the associated motor does not exceed 100 feet.

D. Separate metal conduits shall be provided for each of the following. None of these wiring categories shall be run within the same conduit.

1. Line side, input power wiring
2. Load side, motor power wiring
3. Control or communication wiring
4. Fire alarm system wiring

3.2 START-UP

A. Start-up services shall be provided for each unit by a factory authorized service provider.

1. Complete installation inspection and start-up checks according to manufacturer’s written instructions.

END OF SECTION 230526

SECTION 230529 - HANGERS AND SUPPORTS FOR PIPING AND EQUIPMENT - HVAC

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

B. Section 230200 - Basic Materials and Methods for HVAC shall be included as a part of this Section as though written in full in this document.

1.2 WORK INCLUDED

A. Pipe, and equipment hangers, supports and associated anchors.

B. Sleeves and seals.

C. Flashing and sealing equipment and pipe stacks.

1.3 RELATED WORK

A. Section 230548 - Vibration and Seismic Controls for HVAC Piping and Equipment

B. Section 230716 - HVAC Equipment Insulation

C. Section 230719 - HVAC Piping Insulation

D. Section 232113 - Above Ground Hydronic Piping

E. Section 232116 - Underground Hydronic Piping

1.4 REFERENCES

A. ASME B31.1 - Power Piping; 2024.

B. ASME B31.9 - Building Services Piping; 2020.

C. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2018, with Amendment (2019).

1.5 QUALITY ASSURANCE

A. Hangers and Supports for HVAC Piping: In conformance with ASME B31.1 and ASME B31.9.

B. Hangers and Supports for HVAC Piping: In conformance with MSS SP-58.

1.6 SUBMITTALS

A. Submit shop drawings and product data under provisions of Division One.

B. Indicate hanger and support framing and attachment methods.

C. Provide delegated design submittal for equipment anchorage as required in specification 230200 – Part 1.

PART 2 - PRODUCTS

2.1 PIPE HANGERS AND SUPPORTS

A. Hangers for Pipes Sizes 1/2 to 1-1/2 Inch: Malleable iron, adjustable swivel, split ring.

B. Hangers for Pipes Sizes 2 to 4 Inch: Carbon steel, adjustable clevis.

C. Hangers for Pipes Sizes 6 Inches and Over: Adjustable steel yoke, cast iron roller, double hanger.

D. Multiple or Trapeze Hangers: Steel channels with welded spacers, pre-formed manufactured saddles and hanger rods; cast iron roller and stand for pipe sizes 6 inches and over.

E. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.

F. Wall Support for Pipe Sizes 4 Inches and over: adjustable steel yoke and cast iron roller.

G. Vertical Support: Steel riser clamp.

H. Floor Support for Pipe Sizes to 4 Inches: Cast iron adjustable pipe saddle, locknut nipple, floor flange, and concrete pier or steel support.

I. Floor Support for Pipe Sizes 6 Inches and Over: Adjustable cast iron roller and stand, steel screws, and concrete pier or steel support.

J. Roof Pipe Supports and Hangers: Galvanized Steel Channel System as manufactured by Portable Pipe Hangers, Inc. or approved equal.

1. For pipes 2-1/2” and smaller - Type PP10 with roller
2. For pipes 3” through 8” - Type PS
3. For multiple pipes - Type PSE - Custom

K. Copper Pipe Support and Hangers: Electro-galvanized with thermoplastic elastomer cushions; Unistrut “Cush-A-Clamp” or equal. Hangers: Plastic coated; Unistrut or equal.

L. Shields for Vertical Copper Pipe Risers: Sheet lead.

M. Pipe Rough-In Supports in Walls/Chases: Provide preformed plastic pipe supports, Sioux Chief "Pipe Titan" or equal.

2.2 HANGER RODS

A. Galvanized Hanger Rods: Threaded both ends, threaded one end, or continuous threaded.

2.3 INSERTS

A. Inserts: Malleable iron case with galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

2.4 FLASHING

A. Metal Flashing: 20 gage galvanized steel.

B. Lead Flashing: 4 lb. /sq. ft. sheet lead for waterproofing; 1 lb. /sq. ft. sheet lead for soundproofing.

C. Caps: Steel, 20 gage minimum; 16 gage at fire resistant elements.

D. Coordinate with roofing contractor/Architect for type of flashing on metal roofs.

2.5 EQUIPMENT CURBS

A. Fabricate curbs of hot dipped galvanized steel.

B. For metal roof construction, roof curbs shall be made of aluminum or stainless steel. Coordinate with Architectural Drawings and details.

2.6 SLEEVES

A. Sleeves for Pipes through Non-fire Rated Floors: Form with 18 gage galvanized steel, tack welded to form a uniform sleeve.

B. Sleeves for Pipes through Beams, Interior Walls, Exterior Walls, Footings, and Potentially Wet Floors: Form with steel pipe, Schedule 40, galvanized.

C. Sleeves for Pipes through Fire Rated and Fire Resistive Floors and Fireproofing: Prefabricated fire rated steel sleeves including seals, UL listed, manufactured by Hilti.

D. Fire Stopping Insulation: Glass fiber type, non-combustible, UL listed.

E. Caulk: Paintable 25-year acrylic sealant.

F. Pipe Alignment Guides: Factory fabricated, of cast semi-steel or heavy fabricated steel, consisting of bolted, two-section outer cylinder and base with two-section guiding spider that bolts tightly to pipe. Length of guides shall be as recommended by manufacturer to allow indicated travel.

2.7 mechanical sleeve seals

A. Modular sealing element unit, designed for field assembly, to continuously fill annular space between pipe and sleeve and create watertight seal.

1. Approved Manufacturers:

a. Link-Seal by Garlock Pipeline Technologies (GPT)
b. Innerlynx by Advance Products & Systems, Inc.
c. MetraSeal by Metraflex Co.

2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material, size of pipe, and service requirements.
3. Pressure Plates: Carbon steel. Include two for each sealing element.
4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.8 FABRICATION

A. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.

B. Design hangers without disengagement of supported pipe.

C. Design roof supports without roof penetrations, flashing or damage to the roofing material.

2.9 FINISH

A. Exposed steel hangers, supports, and appurtenances shall be hot-dipped galvanized. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

PART 3 - EXECUTION

3.1 INSERTS

A. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams. Coordinate with Structural Engineer for placement of inserts.

B. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.

C. Where concrete slabs form finished ceiling, provide inserts to be flush with slab surface.

D. Where inserts are omitted, drill through concrete slab from below and provide thru-bolt with recessed square steel plate and nut recessed into and grouted flush with slab. Verify with Structural Engineer prior to start of work.

3.2 pipe hangers and supports

A. Support horizontal piping as follows:

PIPE SIZE	MAX. HANGER SPACING	HANGER DIAMETER
(Steel Pipe)		
1/2 to 1-1/4 inch	7'-0"	3/8"
1-1/2 to 3 inch	10'-0"	3/8"
4 to 6 inch	10'-0"	1/2"
(Copper Pipe)		
1/2 to 1-1/4 inch	5'-0"	3/8"
1-1/2 to 2-1/2 inch	8'-0"	3/8"
3 to 4 inch	10'-0"	3/8"
(Cast Iron Pipe)		
2 to 3 inch	5'-0"	3/8"
4 to 6 inch	10'-0"	1/2"
(PVC Pipe)		
1-1/2 to 4 inch	4'-0"	3/8"
6 to 8 inch	4'-0"	1/2"

B. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.

C. Place a hanger within 12 inches of each horizontal elbow, and at the vertical to horizontal transition.

D. Use hangers with 1-1/2 inch minimum vertical adjustment.

E. Support horizontal cast iron pipe adjacent to each hub, with 5 feet maximum spacing between hangers.

F. Support vertical piping at every floor.

G. For vertical shaft or chase applications where floor slab supported riser clamps cannot be provided to keep the pipe in alignment and to support the weight of the pipe and its contents, ensure to provide suitable fasteners, hardware, braces, unistrut, structural steel members, and appurtenances required to accommodate the pipe installation. Coordinate all such work with the project structural engineer to ensure that necessary members and attachment points are provided accordingly to bear the weight of the functioning piping.

H. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.

I. Support riser piping independently of connected horizontal piping.

J. Install hangers with nut at base and above hanger; tighten upper nut to hanger after final installation adjustments.

K. Portable pipe hanger systems shall be installed per manufacturer's instructions.

L. Distances between supports are maximum distance. Supports shall be provided to carry the pipe/equipment load.

3.3 INSULATED PIPING

A. Clamps: Attach galvanized clamps, including spacers (if any), to piping with clamps projecting through insulation; do not exceed pipe stresses allowed by ASME B31.9.

B. Saddles: Install galvanized protection saddles MSS Type 39 where insulation without vapor barrier is indicated. Fill interior voids with segments of insulation that match adjoining pipe insulation. Secure the full contact area of the saddle to the pipe insulation with 1/8" thick coat of mastic.

C. Shields: Install protective shields MSS SP-58 Type 40 on cold and chilled water piping that has vapor barrier. Secure the full contact area of the shield to the pipe insulation with 1/8" thick coat of mastic.

D. Shields shall span an arc of 180 degrees and shall have dimensions in inches not less than the following:

E.

Nominal Pipe Size	Shield Length	GaugeThickness
1/4 through 3-1/2 inch	12	18
4 inch	12	16
5 through 6 inch	18	16
8 through 14 inch	24	14

F. Piping 2" and larger: provide galvanized sheet metal shields with calcium silicate insulation at hangers/supports.

G. Insert material shall be at least as long as the protective shield.

H. Thermal Hanger Shields: Install where indicated, with insulation of same thickness as piping.

3.4 EQUIPMENT BASES AND SUPPORTS

A. Provide equipment bases of concrete.

B. Provide templates, anchor bolts, and accessories for mounting and anchoring equipment.

C. Refer to specification 230200 – Part 1 for anchorage requirements for roof mounted equipment.

D. Construct support of steel members. Brace and fasten with flanges bolted to structure.

E. Provide rigid anchors for pipes after vibration isolation components are installed.

3.5 FLASHING

A. Provide flexible flashing and metal counter flashing where piping and ductwork penetrate weather or waterproofed walls, floors, and roofs.

B. Provide curbs for mechanical roof installations that extend minimum 8 inches above adjacent roofing surface. Contact Architect for all flashing details and roof construction. Seal penetrations are watertight.

3.6 SLEEVES

A. Sleeves shall be provided at the following locations:

1. Piping passing through rated and non-rated floor assemblies, rated ceiling assemblies, and roof assemblies.
2. Piping passing through concrete, masonry, and rated gypsum board walls and partitions.
3. Piping passing through exterior wall assemblies above and below grade.
4. Piping passing through non-rated gypsum board walls and partitions where indicated on the drawings or where exposed to view.
5. Piping passing through structural members where indicated on the drawings or where exposed to view.
6. Any other locations indicated on the drawings.

B. Set sleeves in position in formwork. Provide reinforcing around sleeves.

C. Extend sleeves through floors minimum one inch above finished floor level. Sleeves located in walls, ceilings, and structural members shall be flush with the outer surfaces of the assembly being penetrated.

D. Where sleeved piping penetrates a floor, ceiling, or interior wall assembly, pack annular space between pipe and sleeve with UL listed fire stopping insulation and caulk seal airtight with fire barrier sealant. Provide close fitting metal collar or escutcheon covers at both sides of wall penetrations and exposed side of ceiling penetrations.

E. Install all UL listed, prefabricated fire rated steel sleeves per the manufacturer’s installation instructions to ensure fire rating is maintained.

F. Sleeves at exterior walls below grade shall be sealed with mechanical sleeve seal. Install seal per manufacturer’s installation instructions. Select type and number of sealing elements required for pipe material, pipe size, and service requirements. Position pipe in center of sleeve. Assemble mechanical sleeve seal and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal. Locations above grade shall be provided with close fitting metal collar or escutcheon covers at both sides of penetration.

END OF SECTION 230529

SECTION 230548 - VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

B. Section 230200 - Basic Materials and Methods for HVAC shall be included as a part of this Section as though written in full in this document.

1.2 WORK INCLUDED

A. Vibration and sound control products.

1.3 QUALITY ASSURANCE

A. Manufacturer’s Qualifications: Firms regularly engaged in manufacture of vibration control products of type, size, and capacity required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Vibration and sound control products shall conform to ASHRAE criteria for average noise criteria curves for all equipment at full load conditions.

C. Unless otherwise indicated, sound and vibration control products shall be provided by a single manufacturer.

1.4 SUBMITTALS

A. SHOP DRAWINGS: Indicate size, material, and finish. Show locations and installation procedures. Include details of joints, attachments, and clearances.

B. PRODUCT DATA: Submit schedules, charts, literature, and illustrations to indicate performance, fabrication procedures, product variations, and accessories.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. VMC Group

B. Mason Industries, Inc.

C. Kinetics Noise Control, Inc.

D. Vibration Eliminator Co., Inc.

E. Vibro-Acoustics

2.2 GENERAL

A. Provide vibration isolation supports for equipment, piping and ductwork, to prevent transmission of vibration and noise to the building structure that may cause discomfort to the occupants.

B. Model numbers of VMC Group products are included for identification. Products of the listed manufacturers will be acceptable provided they comply with all the requirements of this specification.

2.3 FLOOR MOUNTED AIR HANDLING UNITS AND ENERGY RECOVERY UNITS

A. Provide VMC Group model CAL-2 aluminum housed isolators sized for 2” static deflection. Cast iron or steel housings may be used provided they are hot-dip galvanized after fabrication.

B. If floor mounted air handling units are furnished with internal vibration isolation option, provide VMC Group model SP-NRC, style E, consisting of two layers of 1" thick ribbed elastomeric pad bonded to a 16 gauge galvanized steel separator plate to address high frequency breakout and afford additional unit elevation for condensate drains. Ribbed elastomeric pads shall be located in accordance with the air handling unit manufacturer’s recommendations.

2.4 SUSPENDED FANS AND FAN COIL UNITS

A. Provide VMC Group model HS spring hangers sized for 1’’ static deflection.

2.5 CONDENSING UNITS

A. Provide VMC Group model NRC, 1" thick ribbed elastomeric isolation pads sized for approximately 40 psi loading and 1/8’’ deflection.

B. Pads shall be located in accordance with the condensing unit manufacturer’s recommendations.

2.6 PIPING

A. Provide VMC Group model HRS combination spring and elastomeric isolation hangers in mechanical equipment rooms, for a minimum distance of 50 feet from isolated equipment for all chilled water and hot water piping 1-1/2’’ diameter and larger. Isolators shall be sized for the

same deflection as the isolators specified for the equipment up to a maximum of 2" deflection for at least the first three piping hangers; the remaining hangers shall have isolators sized for 1" deflection.

B. Floor supported piping is required to be isolated with VMC Group model AW-1 open springs sized for 1'' deflection.

C. Provide line size flexible connectors at supply and return of pumps, chillers, and all other locations indicated on the mechanical drawings and details. Flexible pipe connectors shall be VMC Group model 2800 single sphere EPDM construction and shall include 150 lb. cadmium plated carbon steel floating flanges.

2.7 CORROSION PROTECTION

A. All vibration isolators shall be designed and treated for resistance to corrosion.

B. Steel components: PVC coated, or phosphate coated and painted with industrial grade enamel. Nuts, bolts, and washers: zinc-electroplated.

PART 3 - EXECUTION

3.1 INSTALLATION

A. All equipment shall be installed in accordance with the manufacturer's recommendations and printed installation instructions.

B. All items required for a complete and proper installation are not necessarily indicated on the plans or in the specifications. Provide all items required as per manufacturer's requirements.

C. If internal isolation option is used on air handling units, the mechanical contractor shall verify proper adjustment and operation of isolators prior to start-up. All shipping brackets and temporary restraint devices shall be removed.

D. The vibration isolation supplier shall certify in writing that he has inspected the installation and that all external isolation materials and devices are installed correctly and functioning properly.

END OF SECTION 230548

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SECTION 230553 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

B. Section 230200 - Basic Materials and Methods for HVAC shall be included as a part of this Section as though written in full in this document.

1.2 SCOPE

A. Scope of the Work shall include the furnishing and complete installation of the equipment covered by this Section, with all auxiliaries, ready for owner's use.

B. Refer to Architectural Sections for additional requirements.

1.3 REFERENCE STANDARDS

A. ASME A13.1 - Scheme for the Identification of Piping Systems; 2023.

PART 2 - PRODUCTS

2.1 VALVE AND PIPE IDENTIFICATION

A. Valves:

1. All valves shall be identified with a 1-1/2" diameter brass disc wired onto the handle. The disc shall be stamped with 1/2" high depressed black filled identifying numbers. These numbers shall be numerically sequenced for all valves on the job.
2. The number and description indicating make, size, model number and service of each valve shall be listed in proper operational sequence, properly typewritten. Three copies to be turned over to Owner at completion.
3. Tags shall be fastened with approved meter seal and 4 ply 0.018 smooth copper wire. Tags and fastenings shall be manufactured by the Seton Name Plate Company or approved equal.
4. All valves shall be numbered serially with all valves of any one system and/or trade grouped together.

B. Pipe Marking:

1. All interior visible piping located in accessible spaces such as above accessible ceilings, equipment rooms, attic space, under floor spaces, etc., shall be identified with all temperature pipe markers as manufactured by W.H. Brady Company, 431 West Rock Ave., New Haven, Connecticut, or approved equal.
2. All exterior visible piping shall be identified with UV and acid resistant outdoor grade acrylic plastic markers as manufactured by Set Mark distributed by Seton (Name plate Company Factory location 20 Thompson Road, Branford, Connecticut) or approved equal.
3. Generally, markers shall be located on each side of each and every partition, on each side of every tee, on each side of every valve and/or valve group, on each side of every piece of equipment, and, for straight runs, at equally spaced intervals not to exceed 75 feet. In congested area, marks shall be placed on each pipe at the points where it enters and leaves the area and at the point of connection of each piece of equipment and automatic control valve. All markers shall have directional arrows.
4. Provide pipe markers that meet labeling requirements of ASME A13.1 for all refrigerant piping located in areas other than the room or space where the associated equipment is located. Pipe markers shall be located at intervals not exceeding 20 feet on the refrigerant piping or pipe insulation. The minimum height of the identification lettering shall be 1/2". The pipe identification shall indicate the refrigerant designation and safety group classification of the refrigerant used in the piping system. For Group A2, A3, B2, and B3 refrigerants, the identification shall also include the following statement: “DANGER – Risk of Fire or Explosion. Flammable Refrigerant.” For any Group B refrigerant, the identification shall also include the following statement: “DANGER – Toxic Refrigerant.”
5. Markers shall be installed after final painting of all piping and equipment and in such a manner that they are visible from the normal maintenance position. Manufacturer's installation instructions shall be closely followed.
6. Markers shall be colored as indicated below per ASME A13.1.

SYSTEM	COLOR	LEGEND
Chilled Water	Green	Chilled Water Supply; Chilled Water Return
Hot Water	Reddish Orange	Hot Water Supply; Hot Water Return

C. Pipe Painting:

1. All piping exposed to view shall be painted as indicated or as directed by the Architect in the field. Confirm all color selections with Architect prior to installation.
2. All piping located in mechanical rooms and exterior piping shall be painted as indicated below:

SYSTEM	SHERWIN-WILLIAMS COLOR NUMBER	SHERWIN-WILLIAMS COLOR NAME
Chilled Water from Chiller	SW-4056 (Dark Blue)	Blueprint
Chilled Water to Chiller	SW-4054 (Light Blue)	Basin
Heating Hot Water from Boiler	SW-6871 (Dark Red)	Positive Red
Heating Hot Water to Boiler	SW-6858 (Light Red)	Zany Pink

2.2 EQUIPMENT IDENTIFICATION

A. Mechanical equipment shall be identified by means of nameplates permanently attached to the equipment. Nameplates shall be engraved laminated plastic or etched metal with minimum 1/2 inch high letters manufactured by Seton Company or approved equal. Submittals shall include dimensions and lettering format for approval. Attachment shall be with escutcheon pins, self-tapping screws, or machine screws.

PART 3 - EXECUTION

3.1 INSTALLATION

A. All labeling equipment shall be installed as per manufacturer’s printed installation instructions.

B. Provide printable label on ceiling grids and access doors at all locations that provide access to mechanical equipment, valves, motorized dampers, and accessories located above ceiling. The label shall be white with black text with 1/4 inch high letters and shall identify the component that is accessible at that location.

C. Provide printable label on ceiling grids and access doors at all locations that provide access to fire dampers, smoke dampers, and combination fire/smoke dampers located above ceiling. The label shall be white with red text with 1/2 inch high letters reading: FIRE/SMOKE DAMPER, SMOKE DAMPER, or FIRE DAMPER to identify the damper type that is accessible at that location.

D. All items required for a complete and proper installation are not necessarily indicated on the plans or in the specifications. Contractor's price shall include all items required as per manufacturer’s requirements.

E. All piping shall be cleaned of rust, dirt, oil and all other contaminants prior to painting. Refer to Division 9 for Architect’s required paint system(s).

END OF SECTION 230553

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SECTION 230593 - TESTING, ADJUSTING, AND BALANCING

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

B. Section 230200 - Basic Materials and Methods for HVAC shall be included as a part of this Section as though written in full in this document.

1.2 RELATED DOCUMENTS

A. Approved submittal date on equipment installed, to accomplish the test procedures, outlined under paragraph 3.01 of this Section, will be provided by the Contractor.

1.3 DESCRIPTION

A. The TAB of the air conditioning systems shall be performed by an impartial technical firm hired by the Owner whose operations are limited only to the field of professional TAB. The TAB work will be done under the direct supervision of a qualified engineer employed by the TAB firm.

B. The TAB firm will be responsible for inspecting, adjusting, balancing, and logging the date on the performance of fans, dampers in the duct system, and air distribution devices. The Contractor and the various Subcontractors of the equipment installed shall cooperate with the TAB firm to furnish necessary data on the design and proper applications of the system components and provide labor and material required to eliminate deficiencies or malperformance.

1.4 QUALITY ASSURANCE

A. QUALIFICATIONS OF CONTRACTOR PERSONNEL: Submit evidence to show that the personnel who shall be in charge of correcting deficiencies for balancing the systems are qualified. The Owner and Engineer reserve the right to require that the originally approved personnel be replaced with other qualified personnel if, in the Owner and Engineer's opinion, the original personnel are not qualified to properly place the system in condition for balancing.

B. QUALIFICATIONS OF TAB FIRM PERSONNEL:

1. A minimum of one registered Professional Engineer licensed in the State is required to be in permanent employment of the firm.

2. Personnel used on the jobsite shall be either Professional Engineers or technicians, who shall have been permanent, full time employees of the firm for a minimum of six months prior to the start of Work for that specified project.
3. Evidence shall be submitted to show that the personnel who actually balance the systems are qualified. Evidence showing that the personnel have passed the tests required by the Associated Air Balance Council (AABC) shall be required.

C. CALIBRATION LIST: Submit to the Engineer for approval, a list of the gauges, thermometers, velometer, and other balancing devices to be used in balancing the system. Submit evidence to show that the balancing devices are properly calibrated before proceeding with system balancing.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 SERVICES OF THE CONTRACTOR

A. The Drawings and Specifications have indicated valves, dampers, and miscellaneous adjustment devices for the purpose of adjustment to obtain optimum operating conditions. Install these devices in a manner that leaves them accessible, and provide access as requested by the TAB firm.

B. Have systems complete and in operational readiness prior to notifying the TAB firm that the project is ready for their services and certify in writing to the Architect and Owner that such a condition exists.

C. As a part of the Work of this Section, make changes in the sheaves, belts, and dampers or the addition of dampers required for correct balance of the new work as required by the TAB firm, at no additional cost to the Owner.

D. Fully examine the existing system to be balanced, to determine whether or not sufficient volume dampers, balancing valves, thermometers, gauges, pressure and temperature taps, means of reading static pressure and total pressure in duct systems, means of determining water flow, and other means of taking data needed for proper water and air balancing are existing. Submit to the Engineer in writing a list of omitted items considered necessary to balance existing systems. Submit the list and proposal as a cost add item.

E. Verify that fresh air louvers are free of blockage, coils are clean and fresh air ducts to each air handling unit have individually adjustable volume regulating dampers.

F. Provide, correct, repair, or replace deficient items or conditions found during the testing, adjusting, and balancing period.

G. In order that systems may be properly tested, balanced, and adjusted as specified, operate the systems at no expense to the Owner for the length of time necessary to properly verify their completion and readiness for TAB period.

H. Project construction schedules shall provide time to permit the successful completion of TAB services prior to Substantial Completion. Complete, operational readiness, prior to commencement of TAB services, shall include the following services of the Contractor:

1. Construction status of building shall permit the closing of doors, windows, ceilings installed and penetrations complete, to obtain project operating conditions.
2. Air distribution systems:

    a. Verify installation for conformity to design. Supply, return, and exhaust ducts terminated, and pressure tested for leakage as specified.
    b. Volume and fire dampers are properly located and functional. Dampers serving requirements of minimum and maximum outside air, return and relief shall provide tight closure and full opening, smooth and free operation.
    c. Supply, return, exhaust and transfer grilles, registers and diffusers shall be installed.
    d. Air handling systems, units and associated apparatus, such as heating and cooling coils, filter sections, access doors, etc., shall be blanked and sealed to eliminate excessive bypass or leakage of air.
    e. Fans (supply and exhaust) operating and verified for freedom from vibrations, proper fan rotation and belt tension; overload heater elements shall be of proper size and rating; record motor amperage and voltage and verify that these functions do not exceed nameplate ratings.
    f. Furnish or revise fan drives or motors as necessary to attain the specified air volumes.

3. Water circulating systems:

    a. Position valves pertinent to system design and require operation to permit full flow of water through system components. Operate hydronic systems under full flow conditions until circulating water is clean. Remove and clean strainers as required during this cycle of operation.
    b. For retrofit projects, record each existing pump motor amperage and voltage. Readings shall not exceed nameplate rating.
    c. Verify, on new equipment, electrical starter overload heater elements to be of proper size and rating.
    d. Ensure that water circulating systems shall be full of water and free of air; expansion tanks set for proper water level, and air vents installed at high points of systems and operating freely. Advise Engineer of deficiencies.
    e. Check and set operating temperatures of heat exchangers to design requirements.
    f. The various existing water circulating systems, including existing strainers, shall be cleaned, filled, purged of air, and put into operation before hydronic balancing.

4. Automatic controls:

    a. Verify that control components are installed in accordance with project documents and functional, electrical interlocks, damper sequences, air and water resets, fire and freeze stats.
    b. Controlling instruments shall be functional and set for design operating conditions. Factory precalibration of room thermostats and pneumatic equipment will not be acceptable.

c. The temperature regulation shall be adjusted for proper relationship between the controlling instruments and calibrated by the TAB Contractor. Advise Engineer of deficiencies or malfunctions.

I. Contractor shall repair any insulation removed from piping system by TAB Contractor during water balancing.

3.2 SERVICES OF THE TAB FIRM

A. The TAB firm will act as liaison between the Owner, Engineer, and the Contractor and inspect the installation of mechanical piping system, sheet metal work, temperature controls and other component parts of the heating, air conditioning and ventilating systems being retrofitted, repaired, or added under this Contract. The reinspection of the Work will cover that part related to proper arrangement and adequate provision for the testing and balancing and will be done when the Work is 80 percent complete.

B. Upon completion of the installation and start-up of the mechanical equipment, to check, adjust, and balance system components to obtain optimum conditions in each conditioned space in the building. Prepare and submit to the Engineer complete reports on the balance and operations of the systems.

C. Measurements and recorded readings of air, water, and electricity that appear in the reports will be done by the permanently employed technicians or engineers of the TAB firm.

D. Make an inspection in the building during the opposite season from that in which the initial adjustments were made. At the time, make necessary modifications to the initial adjustments required to produce optimum operation of system components to affect the proper conditions as indicated on the Drawings. At time of opposite season check-out, the Owner's representative will be notified before readings or adjustments are made.

E. In fan systems, the air quantities indicated on the Drawings may be varied as required to secure a maximum temperature variation of two degrees within each separately controlled space, but the total air quantity indicated for each zone must be obtained. It shall be the obligation of the Contractor to furnish or revise fan drive and motors, if necessary, without cost to the Owner, to attain the specified air volumes.

F. Contractor shall utilize ultrasonic flow meter to balance water flow of existing water system if the original pressure drop data is not available. Contractor shall remove insulation as necessary to use flow meter.

G. Participate in the commissioning process, which shall include but not be limited to attending commissioning meetings, coordinating work with and completing checklists as required by the commissioning team.

3.3 PROFESSIONAL REPORT

A. Before the final acceptance of the report is made, the TAB firm will furnish the Engineer with the following data to be approved by the Owner and Engineer:

1. Summary of main supply, return and exhaust duct pitot tube traverses and fan settings indicating minimum value required to achieve specified air volumes.
2. A listing of the measured air quantities at each outlet corresponding to the temperature tabulation as developed by the Engineer and TAB firm.
3. Air quantities at each return and exhaust air handling device.
4. Static pressure readings entering and leaving each supply fan, exhaust fan, filter, coil, balancing dampers and other components of the systems. Including the retrofit Work. These readings will be related to performance curves in terms of the CFM handled if available.
5. Motor current readings at each equipment motor on load side of capacitors. The voltages at the time of the reading shall be listed.
6. The final report shall certify test methods and instrumentation used, final velocity reading obtained, temperatures, pressure drops, RPM of equipment, amperage of motors, air balancing problems encountered, recommendations and uncompleted punch list items. The test results will be recorded on standard forms.
7. A summary of actual operating conditions shall be included with each system outlining normal and ventilation cycles of operation. The final report will act as a reference of actual operating conditions for the Owner's operating personnel.

3.4 BALANCING AIR CONDITIONING SYSTEM

A. GENERAL:

1. Place all equipment into full operation and continue operating during each working day of balancing and testing. If the air conditioning system is balanced during Off-Peak cooling season Contractor shall return to rebalance air side system as required to put system in proper balance at that season.
2. The Contractor shall submit detailed balancing and recording forms for approval. After approval by the Engineer, prepare complete set of forms for recording test data on each system. All Work shall be done under the supervision of a Registered Professional Engineer. All instruments used shall be accurately calibrated to within 1% of scale and maintained in good working order.
3. Upon completion of the balancing and testing, the TAB Contractor shall compile the test data in report forms, and forward five copies to the Engineer for evaluation.
4. The final report shall contain logged results of all tests, including such data as:

    a. Tabulation of air volume at each outlet.
    b. Outside dry bulb and wet bulb temperature.
    c. Inside dry bulb and wet bulb temperatures in each conditioned space room or area.
    d. Actual fan capacities and static pressures. Motor current and voltage readings at each fan.

B. AIR SYSTEMS: Perform the following operations as applicable to balance and test systems:

1. Check fan rotation.
2. Check filters (balancing shall be done with clean filters).
3. Test and adjust blower rpm to design requirements.
4. Test and record motor full load amperes.
5. Test and record system static pressures, suction and discharge.

6. Test and adjust system for design cfm, return air and outside air (±2%). Change-out fan sheaves as required to balance system.
7. Test and record entering air temperatures, db and wb.
8. Test and record leaving air temperatures, db and wb.
9. Adjust all zones to design cfm (±2%).
10. Test and adjust each diffuser, grille, and register to within 5% of design.

C. AIR DUCT LEAKAGE: (From SMACNA Duct Standards latest edition) Test all ductwork (designed to handle over 1000 CFM) as follows:

1. Test apparatus

   a. The test apparatus shall consist of:
   b. A source of high pressure air - a portable rotary blower or a tank type vacuum cleaner.
   c. A flow measuring device consisting of straightening vanes and an orifice plate mounted in a straight tube with properly located pressure taps. Each orifice assembly shall be accurately calibrated with its own calibration curve. Pressure and flow readings shall be taken with U-tube manometers.

2. Test procedures

   a. Test for audible leaks as follows:

      1) Close off and seal all openings in the duct section to be tested. Connect the test apparatus to the duct by means of a section of flexible duct.
      2) Start the blower with its control damper closed.
      3) Gradually open the inlet damper until the duct pressure reaches 1.5 times the standard designed duct operating pressure.
      4) Survey all joints for audible leaks. Mark each leak and repair after shutting down blower. Do not apply a retest until sealants have set.

   b. After all audible leaks have been sealed, the remaining leakage should be measured with the orifice section of the test apparatus as follows:

      1) Start blower and open damper until pressure in duct reaches 50% in excess of designed duct operating pressure.
      2) Read the pressure differential across the orifice on manometer No. 2. If there is no leakage, the pressure differential will be zero.
      3) Total allowable leakage shall not exceed one (1) percent of the total system design air flow rate. When partial sections of the duct system are tested, the summation of the leakage for all sections shall not exceed the total allowable leakage.
      4) Even though a system may pass the measured leakage test, a concentration of leakage at one point may result in a noisy leak which must be corrected.

D. DX SYSTEMS:

1. Test and record suction and discharge pressures at each compressor and record ambient air temperature entering the condensing coils.

2. Test and record unit full load amps and voltage.
3. Test and record staging and unloading of unit required by sequence of operation or drawing schedule.

E. Automatic temperature controls shall be calibrated; and all thermostats and dampers adjusted so that the control system is in proper operating condition, subject to the approval of the Engineer/Owner.

F. The TAB Contractor shall report to Engineer all air distribution devices or other equipment that operate noisily so that corrective measures may be implemented by the Contractor at no additional cost to the Owner or Architect/Engineer.

END OF SECTION 230593

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SECTION 230713 - DUCT INSULATION

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

B. Section 230200 - Basic Materials and Methods for HVAC shall be included as a part of this Section as though written in full in this document.

1.2 WORK INCLUDED

A. External Duct Insulation

1. Fiberglass / Glass Mineral Fiber Flexible Blanket Insulation
2. Fiberglass / Glass Mineral Fiber Rigid Board Insulation
3. Fiberglass / Glass Mineral Fiber Segmented Board Pipe and Tank Insulation
4. Fiberglass / Glass Mineral Fiber Continuous Mat Pipe and Tank Insulation
5. Fire-Rated High-Temperature Ceramic Fiber Flexible Blanket Insulation

B. Internal Duct Insulation

1. Fiberglass / Glass Mineral Fiber Flexible Duct Liner Insulation
2. Fiberglass / Glass Mineral Fiber Rigid Plenum Liner Insulation

C. Adhesives

D. Mastics

E. Lagging Adhesives

F. Sealants

G. Glass Fiber Fabric Reinforcing Mesh

H. Securements

1.3 RELATED SECTIONS

A. Section 230529 - Hangers and Supports for Piping and Equipment - HVAC

B. Section 230553 - Identification for HVAC Piping and Equipment

C. Section 233113 - Metal Ductwork

1.4 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. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

C. ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications; 2023a.

D. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.

E. ASTM C165 - Standard Test Method for Measuring Compressive Properties of Thermal Insulations; 2023.

F. ASTM C1071 - Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material); 2019.

G. ASTM C1136 - Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation; 2023.

H. ASTM C1290 - Standard Specification for Flexible Fibrous Glass Blanket Insulation Used to Externally Insulate HVAC Ducts; 2016 (Reapproved 2021).

I. ASTM C1393 - Standard Specification for Perpendicularly Oriented Mineral Fiber Roll and Sheet Thermal Insulation for Pipes and Tanks; 2019.

J. ASTM C1338 - Standard Test Method for Determining Fungi Resistance of Insulation Materials and Facings; 2019 (Reapproved 2022).

K. ASTM D1644 - Standard Test Methods for Nonvolatile Content of Varnishes; 2001.

L. ASTM C423 - Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method; 2023.

M. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications; 2013 (Reapproved 2019).

N. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation; 2014 (Reapproved 2019).

O. ASTM C916 - Standard Specification for Adhesives for Duct Thermal Insulation; 2020.

P. ASTM E136 - Standard Test Method for Assessing Combustibility of Materials Using a Vertical Tube Furnace at 750 Degrees C; 2024.

Q. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2023a.

R. ASTM E1966 - Standard Test Method for Fire-Resistive Joint Systems; 2015 (Reapproved 2019).

S. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

T. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2023.

U. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2015, with Editorial Revision (2021).

V. ASTM G22 - Standard Practice for Determining Resistance of Plastics to Bacteria; 2023.

W. ICC (IECC) - International Energy Conservation Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

X. MIL-DTL-3316 - Adhesives, Fire-Resistant, Thermal Insulation; 2020d.

Y. NAIMA FGDLS - North American Insulation Manufacturers Association (NAIMA) Fibrous Glass Duct Liner Standards; Current Edition, Including All Revisions.

Z. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2024.

AA. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems; 2024.

BB. SCAQMD 1168 - Adhesive and Sealant Applications; 1989, with Amendment (2022).

CC. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2020.

DD. UL 2824 - GREENGUARD Certification Program Method for Measuring Microbial Resistance from Various Sources Using Static Environmental Chambers; Current Edition, Including All Revisions.

EE. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

FF. UL 2043 - Fire Test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air-Handling Spaces; Current Edition, Including All Revisions.

1.5 QUALITY ASSURANCE

A. Installer’s Qualifications: Firm with at least 5 years successful installation experience on projects with mechanical insulations similar to that required for this project.

B. All insulation shall be listed and labeled to have a composite (insulation, jacket or facing, and adhesive used to adhere the facing or jacket to insulation) flame spread index of not more than

25 and smoke-developed index of not more than 50 when tested in accordance with ASTM E84 and UL 723.

1. Exception: Outdoor mechanical insulation may have flame spread index of 75 and smoke developed index of 150.

C. Duct and plenum insulation shall comply with minimum R-value requirements of ICC (IECC) and ASHRAE Std 90.1 I-P unless greater values are indicated otherwise in the contract documents.

D. Adhesive and other insulation materials shall comply with NFPA 90A and NFPA 90B. Additionally, all adhesives and sealants used on the interior of the building (i.e., inside of the weatherproofing system and applied on-site) shall be comprised of low-emitting materials that comply with VOC limits prescribed by SCAQMD 1168.

E. Vapor retarder mastics used on the interior of the building shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D

F. Insulations shall not contain formaldehyde, asbestos, lead, mercury, mercury compounds, or polybrominated diphenyl, ether fire retardants.

G. Fiberglass insulations shall have a minimum of 50 percent recycled glass content.

H. Fiberglass insulations shall have a formaldehyde-free binder and shall be UL GREENGUARD Gold certified.

1.6 WARRANTY

A. Warrant the Work specified herein for one year against becoming unserviceable or causing an objectionable appearance resulting from either defective, or nonconforming materials and workmanship.

B. Defects shall include, but not be limited to, the following:

1. Mildewing.
2. Peeling, cracking, and blistering.
3. Condensation on exterior surfaces.

1.7 SUBMITTALS

A. SHOP DRAWINGS: Indicate size, material, and finish. Show locations and installation procedures. Include details of joints, attachments, and clearances.

B. PRODUCT DATA: Submit schedules, charts, literature, and illustrations to indicate the performance, fabrication procedures, product variations, and accessories.

1.8 DELIVERY, STORAGE AND HANDLING

A. Deliver insulation materials to site in unopened containers with manufacturer's product name, ASTM standard designation, type and grade, maximum use temperature, nominal dimensions, manufacturer lot or date code.

B. Protect insulation against dirt, water, and chemical and mechanical damage. Do not install damaged or wet insulation; remove such from project site.

PART 2 - PRODUCTS

2.1 GENERAL DESCRIPTION

A. The type of insulation and its installation shall be in strict accordance with these specifications for each service, and the application technique shall be as recommended by the manufacturer. All insulation types, together with adhesives and finishes shall be submitted and approved before any insulation is installed.

B. A sample quantity of each type of insulation and each type of application shall be installed and approval secured prior to proceeding with the main body of the Work.

2.2 ACCEPTABLE MANUFACTURERS

A. Fiberglass/Glass mineral fiber materials shall be as manufactured by Knauf Insulation, Certain-Teed, Johns-Manville or Owens-Corning and shall have the same thermal properties, density, fire rating, vapor retarder, etc., as the types specified herein, subject to review by the Engineer.

B. Adhesives, mastics, and sealants shall be as manufactured by 3M Company, Carlisle/Hardcast, Design Polymerics, Foster/Childers, Mon-Eco Industries, or Vimasco Corporation and shall have the same adhesive properties, fire rating, vapor seal, etc., as the types specified herein, subject to review by the Engineer.

C. Ceramic fiber materials shall be as manufactured by 3M Company, Alkegen/Unifrax, or Morgan Advanced Materials/Thermal Ceramics.

D. Metal jacketing and fitting covers shall be as manufactured by Johns Manville or RPR Products, Inc.

2.3 EXTERNAL INSULATIONS

A. Fiberglass / Glass Mineral Fiber Flexible Blanket Insulation: Glass fibers bonded with a thermosetting resin, complying with ASTM C1290 and ASTM C553, Type I, II, and III. Provide insulation with factory applied FSK vapor retarding facing complying with ASTM C1136, Type I, II, VIII, X. Thermal conductivity (k-value) at 75 degrees F mean temperature shall be 0.27 Btu x in. /h x sq. ft. x degrees F, or less. Maximum service temperature of 250 degrees F with facing, 350 degrees F for unfaced material. Provide Knauf Insulation

Atmosphere Duct Wrap with ECOSE Technology, Johns Manville Microlite FSK or approved equal.

B. Fiberglass / Glass Mineral Fiber Rigid Board Insulation: Glass fibers bonded with a thermosetting resin, complying with ASTM C553 Type I, II, III, ASTM C612 Type IA, IB. Provide insulation with factory applied FSK facing vapor retarder facing complying with ASTM C1136, Type I, II. Thermal conductivity (k-value) at 75 degrees F mean temperature shall be 0.24 Btu x in. /h x sq. ft. x degrees F, or less. Maximum service temperature of 450 degrees F. Provide Knauf Insulation Earthwool Insulation Board with ECOSE Technology, Johns Manville 800 Series Spin-Glas or approved equal.

C. Fiberglass / Glass Mineral Fiber Segmented Board Pipe and Tank Insulation: Glass fibers bonded with a thermosetting resin, complying with ASTM C1393, Category 1. Semi-rigid, segmented board in roll form with glass fibers adhered perpendicular to the vapor retarder facing. Provide insulation with factory applied FSK vapor retarder facing complying with ASTM C1136, Type II, IV, X. Compressive strength per ASTM C165 C165, not less than 120 PSF at 10% deformation. Thermal conductivity (k-value) at 100 degrees F mean temperature shall be 0.26 Btu x in. /h x sq. ft. x degrees F, or less. Maximum service temperature of 850 degrees F. Provide Knauf Insulation Earthwool Pipe & Tank Insulation with ECOSE Technology or approved equal.

D. Fiberglass / Glass Mineral Fiber Continuous Mat Pipe and Tank Insulation: Glass fibers bonded with a thermosetting resin, complying with ASTM C1393; Type I, II, IIIA, IIIB Category 2. Semi-rigid, continuous mat in roll form. Provide insulation with factory applied FSK vapor retarder facing complying with ASTM C1136, Type II, IV, X. Compressive strength per ASTM C165, not less than 25 PSF at 10% deformation. Thermal conductivity (k-value) at 100 degrees F mean temperature shall be 0.25 Btu x in. /h x sq. ft. x degrees F, or less. Maximum service temperature of 850 degrees F. Provide Knauf Insulation KwikFlex Pipe & Tank Insulation, Johns Manville Micro-Flex or approved equal.

E. Fire-Rated High-Temperature Ceramic Fiber Flexible Blanket Insulation: High-temperature ceramic fiber blanket thermal insulation encapsulated in a fiberglass reinforced aluminized polyester foil. Fire-rated blanket insulation shall have a nominal thickness of 1-1/2” and a nominal density of 6.0 pcf. Provide 3M Fire Barrier Duct Wrap 615+, Alkegen/Unifrax FyreWrap Elite 1.5, or Morgan Advanced Materials/Thermal Ceramics FireMaster FastWrap XL.

2.4 INTERNAL INSULATIONS

A. Fiberglass / Glass Mineral Fiber Flexible Duct Liner Insulation: Rotary glass fibers bonded with thermosetting resin, complying with ASTM C1071 Type I. Airstream side to have a tightly bonded, black mat finish withstanding maximum rated air velocity of 6,000 ft/minute. Mat finish shall be treated with EPA-registered biocide for use in HVAC systems and verified to be microbially resistant in accordance with ASTM G21, ASTM G22, ASTM C1338, and UL 2824. The outer edges of the Liner shall have a factory applied encapsulating coating. Nominal density shall be 1.5 pcf minimum and when tested in accordance with ASTM C423 (Type A Mounting), shall provide a Noise Reduction Coefficient of 0.70 at 1.0”, 0.80 at 1.5”, and 0.95 at 2.0” thickness. Maximum service temperature of 250 degrees F. Thermal Conductivity (k-value) at 75 degrees F mean temperature shall be 0.24 Btu x in. /h x sq. ft. x degrees F, or less.

Provide Knauf Insulation Atmosphere Duct Liner with ECOSE Technology, Johns Manville Linacoustic RC or approved equal.

B. Fiberglass / Glass Mineral Fiber Rigid Plenum Liner Insulation: Glass fibers bonded with thermosetting resin, complying with ASTM C1071 Type II. Airstream side to have a tightly bonded, black mat finish withstanding maximum rated air velocity of 5,000 ft/minute. Mat finish shall be treated with EPA-registered biocide for use in HVAC systems and verified to be microbially resistant in accordance with ASTM G21 and ASTM C1338. The outer edges of the Liner shall have a factory applied encapsulating coating. Nominal density shall be 3.0 pcf minimum and when tested in accordance with ASTM C423 (Type A Mounting), shall provide a minimum Noise Reduction Coefficient of 0.65 at 1.0", 0.85 at 1.5", at 0.95 at 2.0" thickness. Maximum service temperature of 250 degrees F. Thermal Conductivity (k-value) at 75 degrees F mean temperature shall be 0.23 Btu x in. /h x sq. ft. x degrees F, or less. Provide Knauf Insulation Atmosphere Rigid Plenum Liner with ECOSE Technology, Johns Manville Linacoustic R-300 or approved equal.

2.5 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

B. Fiberglass / Glass Mineral Fiber Adhesive: Comply with MIL-DTL-3316C, Class 2, Grade A. Provide Childers CP-82 or approved equal.

C. Duct Liner Adhesive: Duct Liner adhesives shall comply with ASTM C916.

2.6 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates.

B. Vapor-Retarder Mastic: Water based; suitable for indoor and outdoor use on below ambient services. Water-Vapor Permeance shall be 0.09 perms at 55-mils dry film thickness when tested in accordance with ASTM E96/E96M, Procedure A. Service Temperature Range shall be -20 to +180 degrees F. Solids content shall be 59 percent by volume and 71 percent by weight per ASTM D1644. Provide Childers CP-35 or approved equal.

2.7 LAGGING ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates.

B. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct, equipment, and pipe insulation. Service Temperature Range shall be 0 to +180 degrees F. Provide Childers CP-52 or approved equal.

2.8 SEALANTS

A. Materials shall be compatible with insulation materials, jackets, and substrates.

B. FSK and Metal Jacket Flashing Sealants shall be fire and water-resistant, flexible, elastomeric sealants with a service temperature range of -40 to +250 degrees F. Provide Childers CP-76 or approved equal.

C. Fire Barrier Sealant shall be a latex-based, intumescent sealant that dries to form a monolithic firestop seal. Fire barrier sealant shall be firestop tested up to 4 hours in accordance with ASTM E814 and fire resistance tested in accordance with ASTM E1966. Provide 3M CP 25WB+ or approved equal.

2.9 GLASS FIBER FABRIC REINFORCING MESH

A. Woven Glass Fiber Fabric: Approximately 2 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. inch. Provide Childers Chil-Glas No. 10 or approved equal.

2.10 SECUREMENTS

A. Bands

1. Approved Manufacturers

a. Childers
b. PABCO
c. RPR Products

2. Stainless Steel: ASTM A240/A240M, Type 304 or Type 316; 0.015 inch thick, 3/4 inch wide with wing or closed seal.
3. Aluminum: ASTM B209/B209M, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 3/4 inch wide with wing or closed seal.
4. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

B. Insulation Pins

1. Approved Manufacturers

a. AGM Industries, Inc.
b. Midwest Fasteners, Inc.
c. GEMCO
d. Duro-Dyne

2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch-diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.

3. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, minimum 0.106-inch-diameter shank, length to suit depth of insulation indicated.
4. Insulation Retaining Washers: Self-locking washers formed from 0.016 inch thick, galvanized steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.

C. Staples

1. Outward-clinching insulation staples, nominal 1/2-inch-wide, stainless steel or Monel.

PART 3 - EXECUTION

3.1 GENERAL

A. To ensure that external fiberglass/glass mineral fiber flexible blanket and rigid board insulation will achieve its highest possible performance and serve its intended purpose, install all mechanical insulation materials and associated accessories in accordance with manufacturer’s published instructions and industry practices detailed by the North American Commercial and Industrial Insulation Standards (NACIIS) Manual as published by the Midwest Insulation Contractors Association (MICA).

B. To ensure that internal fiberglass/glass mineral fiber flexible duct and rigid plenum liner insulation will achieve its highest possible performance and serve its intended purpose, install duct liner, plenum liner, and all associated accessories in accordance with manufacturer’s published instructions and industry practices detailed by NAIMA FGDLS and SMACNA (DCS).

C. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

D. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces, free of voids throughout the length of, ducts and fittings.

E. All items required for a complete and proper installation are not necessarily indicated on the plans or in the specifications. Provide all items required as per manufacturer's requirements.

3.2 EXTERNAL DUCT INSULATION

A. Fasten all longitudinal and circumferential laps with outward clinching staples 3" on center. On rectangular ducts over 24" wide apply as above and hold insulation in place on bottom side with mechanical pins and clips on 12" centers.

B. Seal all joints, fastener penetrations and other breaks in vapor retarder with 3-inch wide strips of glass fiber fabric reinforcing mesh embedded between two coats of vapor retarder mastic.

C. External duct wrap is required on all outside air ducts, supply and return air ducts that are not internally insulated. External duct wrap is also required on all exhaust and relief air ducts that are used in airside energy recovery systems. Any exhaust ductwork located in an unconditioned space that conveys air from conditioned spaces or vice versa shall also be provided with external duct wrap. Duct wrap shall be provided as follows:

1. 1½" thick, 1.0 pcf density minimum; minimum installed R-value of 4.5 when ducts are located in directly conditioned spaces.
2. 2" thick, 1.0 pcf density minimum; minimum installed R-value of 6.0 when ducts are located in indirectly conditioned spaces such as ceiling plenum space used for return air or located indoors concealed within chases or shafts.
3. 3" thick, 0.75 pcf density minimum; minimum installed R-value of 8.3 when ducts are located in unconditioned spaces.

D. Any ductwork located in an air plenum that is comprised of materials that do not comply with the 25/50 flame and smoke rating per ASTM E84 or UL 723 testing requirements or UL 2043 for discrete products in plenums shall be provided with a single layer of duct wrap to establish a noncombustible rating per ASTM E136. Duct wrap products which are approved for such non-compliant combustible duct materials located in air plenums shall be 3M Fire Barrier Plenum Wrap 5A+ or Alkegen/Unifrax FyreWrap 0.5 Plenum. Insulation products for this application shall be installed in strict accordance with the manufacturer's instructions.

3.3 DUCT LINER

A. Duct liner shall be kept clean and dry during transportation, storage, installation, and throughout the construction process care should be taken to protect the liner from exposure to the elements or damage from mechanical abuse.

B. Duct liner shall be adhered to the sheet metal with a full coverage of approved adhesive complying with ASTM C916. All exposed leading edges and transverse joints shall be coated with factory-applied or field-applied edge coating, Childers CP-50A HV2 Black or approved equal and shall be neatly butted without gaps. Shop or field cuts shall be liberally coated with an edge coating. All coatings and adhesives shall be designed for duct liner application.

C. Metal nosings shall be securely installed over transversely oriented liner edges facing the airstream at forward discharge and at any point where lined duct is preceded by unlined duct.

D. When velocity exceeds 4,000 fpm (20.3 m/sec), use metal nosing on every leading edge. Nosing may be formed on duct or be channel or zee attached by screws, rivets or welds.

E. Line supply and return ductwork at connection of fan-powered HVAC units to a point of 15 feet upstream and downstream of the equipment, 15 feet downstream of fan powered terminal units, and in return air boots.

F. Duct liner shall be provided as follows:

1. 1" thick, 1.5 pcf density minimum, with a minimum installed R-value of 4.2 when ducts are located in directly conditioned spaces.

2. 1 ½" thick, 1.5 pcf density minimum, with a minimum installed R-value of 6.0 when ducts are located in indirectly conditioned spaces such as ceiling plenum space used for return air.
3. 2" thick, 1.5 pcf density minimum, with a minimum installed R-value of 8.0 when ducts are located in indoor, unconditioned spaces or located outdoors.
4. 1 ½" thick, 3.0 pcf density minimum, with a minimum R-value of 6.3 for rigid plenum liner applications.

3.4 EXPOSED DUCTWORK LOCATED INDOORS

A. Duct required to be insulated by any section of this specification that is routed exposed in occupied spaces shall be double wall.

B. Duct routed exposed shall be double wall with perforated inner liner and fiberglass/glass mineral fiber insulation. Provide 1" thick insulation when ductwork is located in conditioned spaces and 2" thick in unconditioned spaces, insulation density shall be a minimum of 1.0 pcf. Double wall duct shall be United McGill model Acousti-k27 for round or oval ducts and Rectangular-k27 for rectangular ducts or approved equal.

3.5 AIR DEVICE AND MISCELLANEOUS DUCT INSULATION

A. The backside of all supply air devices shall be insulated with taped and sealed external duct wrap matching the thickness, density, and R-value of the associated duct system.

B. The contractor shall install an additional layer of 1-½ inch thick external fiberglass / glass mineral fiber duct wrap on any portion of the supply air, return air, outside air, or exhaust air system that has condensation forming during any period of operation. The insulation shall be taped and vapor-sealed and located until all evidence of the condensation has been eliminated, at no additional cost to the Owner.

END OF SECTION 230713

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SECTION 230719 - HVAC PIPING INSULATION

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

B. Section 230200 - Basic Materials and Methods for HVAC shall be included as a part of this Section as though written in full in this document.

1.2 SCOPE

A. Scope of the Work shall include the furnishing and complete installation of the equipment covered by this Section, with all auxiliaries, ready for Owner's use.

B. Furnish and install piping insulation to:

1. Chilled water and heating hot water piping.
2. Condensate drain piping.
3. Refrigerant piping.
4. All pipes subject to freezing conditions shall be insulated.

C. Work specified elsewhere.

1. Painting.
2. Pipe hangers and supports.

D. For insulation purpose piping is defined as the complete piping system including supplies and returns, pipes, valves, automatic control valve bodies, fittings, flanges, strainers, thermometer well, unions, reducing stations, and orifice assemblies.

1.3 RELATED SECTIONS

A. Section 230529 - Hangers and Supports for Piping and Equipment - HVAC

B. Section 230553 - Identification for HVAC Piping and Equipment

C. Section 232113 - Above Ground Hydronic Piping

D. Section 232300 - Refrigerant Piping

1.4 REFERENCE STANDARDS

A. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

B. ASTM C1126 - Standard Specification for Faced or Unfaced Rigid Cellular Phenolic Thermal Insulation; 2019.

C. ASTM C1136 - Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation; 2023.

D. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form; 2023.

E. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation; 2022a.

F. ASTM E136 - Standard Test Method for Assessing Combustibility of Materials Using a Vertical Tube Furnace at 750 Degrees C; 2024.

G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

H. ICC (IECC) - International Energy Conservation Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

I. SCAQMD 1168 - Adhesive and Sealant Applications; 1989, with Amendment (2022).

J. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.5 WARRANTY

A. Warrant the Work specified herein for one year against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials or workmanship.

B. Defects shall include, but not be limited to, the following:

1. Mildewing.
2. Peeling, cracking, and blistering.
3. Condensation on exterior surfaces.

1.6 SUBMITTALS

A. SHOP DRAWINGS: Indicate size, material, and finish. Show locations and installation procedures. Include details of joints, attachments, and clearances.

B. PRODUCT DATA: Submit schedules, charts, literature, and illustrations to indicate the performance, fabrication procedures, project variations, and accessories.

1.7 DELIVERY AND STORAGE

A. Deliver insulation, coverings, cements, adhesives, and coatings to site in unopened containers with manufacturer's stamp, clearly labeled with flame and smoke rating, affixed showing fire hazard indexes of products.

B. Protect insulation against dirt, water and chemical and mechanical damage. Do not install damaged or wet insulation; remove such from project site.

PART 2 - PRODUCTS

2.1 HVAC PIPING INSULATION

A. It is the intent of these specifications to secure superior quality workmanship resulting in an absolutely satisfactory installation of insulation from the standpoint of both function and appearance. Particular attention shall be given to valves, fittings, pumps, etc., requiring low temperature insulation to insure full thickness of insulation and proper application of the vapor seal. All flaps of vapor barrier jackets and/or canvas covering must be neatly and securely smoothed and sealed down.

B. The type of insulation and its installation shall be in strict accordance with these specifications for each service, and the application technique shall be as recommended by the manufacturer. All insulation types, together with adhesives and finishes shall be submitted and reviewed prior to installation.

C. A sample quantity of each type of insulation and each type application shall be installed and accepted prior to proceeding with the main body of the work. Condensation caused by improper installation of insulation shall be corrected by Installing Contractor. Any damage caused by condensation shall be made good at no cost to the Owner or Architect/Engineer.

D. All insulation shall be listed and labeled to have a composite (insulation, jacket or facing, and adhesive used to adhere the facing or jacket to insulation) flame spread index of not more than 25 and smoke-developed index of not more than 50 when tested in accordance with ASTM E84 or UL 723.

1. Exception: Outdoor mechanical insulation may have flame spread index of 75 and smoke developed index of 150.

E. All HVAC piping insulation thicknesses shall comply with minimum requirements of ICC (IECC) and ASHRAE Std 90.1 I-P.

F. Accessories, such as adhesives, mastics and cements shall have the same component ratings as listed above. Additionally, all adhesives and sealants used on the interior of the building (i.e.,

inside of the weatherproofing system and applied on-site) shall be comprised of low-emitting materials that comply with VOC limits prescribed by SCAQMD 1168.

G. All products or their shipping cartons shall have a label affixed, indicating flame and smoke ratings do not exceed the above requirements.

H. Any existing piping located in an air plenum that is comprised of materials that do not comply with the 25/50 flame and smoke rating per ASTM E84 testing requirements shall be provided with a single layer of high-temperature insulation to establish a noncombustible rating per ASTM E136. Insulation products which are approved for such non-compliant combustible piping materials located air plenums shall be 3M Fire Barrier Plenum Wrap 5A+ or Unifrax FyreWrap 0.5 Plenum. Insulation products for this application shall be installed in strict accordance with the manufacturer's instructions.

2.2 APPROVED MANUFACTURERS

A. Calcium silicate materials shall be as manufactured by Johns Manville.

B. Glass mineral wool materials shall be as manufactured by Knauf Insulation, Johns Manville or Owens-Corning and shall have the same thermal properties, density, fire rating, vapor barrier, etc., as the types specified herein, subject to review by the Engineer. All glass mineral wool insulation shall be UL GREENGUARD Gold certified.

C. Adhesives shall be as manufactured by Childers, Foster, HB Fuller or Armacell, and shall have the same adhesive properties, fire rating, vapor seal, etc., as the types specified herein, subject to review by the Engineer.

D. Flexible elastomeric cellular thermal insulation by Armacell.

E. Phenolic foam insulation shall be as manufactured by Resolco, Inc. (Insul-Phen) or Polyguard (Poly-phen).

F. Metal jacketing and fitting covers shall be as manufactured by Childers or RPR Products.

2.3 MATERIALS

A. CHILLED WATER PIPING: Provide phenolic foam in accordance with ASTM C1126 with ASJ jacket and all joints sealed.

B. HEATING HOT WATER PIPING: Provide glass mineral wool pipe insulation in accordance with ASTM C547 with ASJ+ SSL+ jacket or phenolic foam in accordance with ASTM C1126 with ASJ and all joints sealed.

C. CONDENSATE DRAINAGE PIPING: Provide flexible elastomeric cellular thermal insulation in accordance with ASTM C534/C534M, model "Armaflex Ultima", fire rated for use in environmental air plenums; insulation not required when piping is exposed on roof.

D. REFRIGERANT PIPING: Provide flexible elastomeric cellular thermal insulation in accordance with ASTM C534/C534M. Provide model "Armaflex Ultima", fire rated for use in environmental air plenums for all indoor applications. Provide model "AP Armaflex", for all outdoor applications. Apply manufacturers recommended finish and sealant for outdoor applications.

E. METAL JACKETING: Utilize Childers “Strap-On” jacketing. Provide preformed fitting covers for all elbows and tees.

F. ALL SERVICE JACKETING (ASJ+): Vapor retarder jacket for interior applications shall be composed of an aluminum foil layer, reinforced with glass scrim, bonded to a layer of white kraft paper, interleaving with an outer polymer film leaving no paper exposed; complying with ASTM C1136. Vapor retarder jacket for exterior applications shall be composed of a 3-ply composite membrane consisting of a white 0.5 mil polyester film, 1.0 mil aluminum foil, and one 0.5 mil clear polyester film; complying with ASTM C1136.

PART 3 - EXECUTION

3.1 GENERAL

A. All insulation shall be installed in accordance with the manufacturer’s recommendations and printed installation instructions, including high density inserts at all hangers and pipe supports to prevent compression of insulation.

B. All items required for a complete and proper installation are not necessarily indicated on the plans or in the specifications. Provide all items required as per manufacturer’s requirements.

C. All heat recovery piping between air conditioning equipment and hydronic or domestic hot water piping shall be insulated per the High Temperature Surfaces Schedule below.

D. All condenser water piping located in a ceiling plenum shall be insulated per the requirements for indoor chilled water piping as indicated in the Low Temperature Surfaces Schedule below.

E. Pipes located outdoors or in tunnels shall be insulated same as concealed piping and shall have a jacket of 0.016 inch thick, smooth aluminum with longitudinal modified Pittsburg Z-Lock seam and 2 inch overlap. Jacketing shall be easily removed and replaced without damage. All insulation butt joints shall be sealed with gray silicone. Galvanized banding is not acceptable.

F. All insulated piping located over driveways shall have an aluminum shield permanently banded over insulation to protect it from damage from car antennas.

G. Provide all HVAC piping insulation to comply with the ASHRAE Std 90.1 I-P Minimum Thickness Schedule and as indicated below.

1. Minimum Insulation Thickness for Low Temperature Surfaces

    a. Condensate drain lines: 1 inch
    b. Chilled Water Piping:

1) Located outdoors: 2 inch
2) Located indoors:

a) 4 inch and smaller: 1-½ inch
b) Larger than 4 inch: 2 inch

c. Refrigerant Piping

1) 1½“ and smaller: 1 inch
2) Larger than 1½ inch: 1-½ inch

2. Minimum Insulation Thickness for High Temperature Surfaces

a. Hot Water Piping:

1) Operating temperature 105°F or less: 1 inch
2) Operating temperature higher than 105°F and pipe size 1-¼ inch or smaller: 1-½ inch
3) Operating temperature higher than 105°F and pipe size greater than 1-¼ inch: 2 inch

b. Refrigerant Piping

1) 1-½ inch and smaller: 1-½ inch
2) Larger than 1-½ inch: 2 inch

3.2 WATER PIPE INSULATION INSTALLATION

A. The insulation shall be applied to clean, dry pipes with all joints firmly butted together. Where piping is interrupted by fittings, flanges, valves or hangers and at intervals not to exceed 25 feet on straight runs, a vapor dam shall be formed between the vapor retarder jacket and the bare pipe. The seal shall be by the applications of vapor retarder mastic to the exposed insulation joint faces, carried continuously down to and along 4 inches of pipe and up to and along 2 inches of jacket.

B. Pipe fittings and valves shall be insulated with pre-molded or shop fabricated glass mineral wool covers finished with two brush coats of vapor retarder mastic reinforced with glass fabric.

C. All under lap surfaces shall be clean and free of dust, etc. before the joint is sealed. These laps shall be firmly rubbed to insure a positive seal. A brush coat of vapor retarder mastic shall be applied to all edges of the vapor retarder jacket.

3.3 FIRE RATED INSULATION

A. All pipe penetrations through walls and concrete floors shall be fire rated by applying Owens Corning Thermafiber in the space between the concrete and the pipe.

B. The penetration shall be additionally sealed by using 3M brand model CP 25 or 303 fire barrier caulk and putty.

C. All fire rating material shall be insulated in accordance with manufacturer's printed instructions.

END OF SECTION 230719

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SECTION 230800 - COMMISSIONING OF HVAC SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract Documents, including General and Supplementary Conditions and Division 01 Specifications, apply to this section.

1.2 RELATED SECTIONS:

A. Section 019100 - General Commissioning Requirements

B. Section 230963 - Energy Management and Control System (EMCS)

1.3 SUMMARY

A. The commissioning of the HVAC system and associated controls shall be performed by an impartial technical firm hired by the owner. The commissioning provider shall be certified under one or more of the following certifications:

1. CxA - Certified Commissioning Authority - ACG
2. CBCP - Certified Building Commissioning Professional - AEE
3. CCP - Certified Commissioning Professional - BCA
4. CPMP - Certified Process Management Professional - ASHRAE
5. BSC - Building System Commissioning Certification - NEBB

B. The commissioning provider (Commissioning authority) shall be responsible for leading the entire construction team through the commissioning process including, but not limited to, conducting the commissioning kick-off meeting, preparing the commissioning plan, preparing pre-functional checklists, preparing functional test scripts, participation in functional testing and preparation of required documentation and reports.

1.4 RESPONSIBILITIES

A. Contractor: Responsibilities of the Contractor as related to the Commissioning Process include, but are not limited to the following:

1. Facilitate coordination of Commissioning work by Commissioning authority.
2. Attend Commissioning meetings or other meetings called by Commissioning authority to facilitate the Commissioning Process.
3. Review Functional Performance Test procedures for feasibility, safety, and impact on warranty, and provide Commissioning authority with written comment on same.
4. Provide all documentation relating to manufacturer’s recommended performance testing of equipment and systems.

5. Provide Operations & Maintenance data to Commissioning authority for preparation of checklists and training manuals.
6. Provide Testing and Balancing Report before Functional Testing begins.
7. Provide As-built drawings and documentation to facilitate Testing.
8. Assure and facilitate participation and cooperation of Sub Contractors and equipment suppliers as required for the Commissioning Process.
9. Certify to Commissioning authority that installation work listed in Pre-Functional Checklists has been completed.
10. Install systems and equipment in strict conformance with project specifications, manufacturer's recommended installation procedures, and Pre-Functional Checklists.
11. Provide data concerning performance, installation, and start-up of systems.
12. Provide copy of manufacturers filled-out start-up forms for equipment and systems.
13. Ensure systems have been started and fully checked for proper operation prior to arranging for Testing with Commissioning authority. Prepare and submit to Commissioning authority **written** certification that each piece of equipment and/or system has been started according to manufacturer's recommended procedure, and that system has been tested for compliance with operational requirements.

    a. Contractor shall carry out manufacturer's recommended start-up and testing procedures, regardless of whether or not they are specifically listed in Pre-Functional Checklists.
    b. Contractor is not relieved of obligation for systems/equipment demonstration where performance testing is required by specifications, but a Functional Performance Test is not specifically designated by Commissioning authority.

14. Coordinate with Commissioning authority to determine mutually acceptable date of Functional Performance Tests.
15. Provide qualified personnel to assist and participate in Commissioning.
16. Provide test instruments and communications devices, as prescribed by Commissioning authority, required for carrying out Testing of systems.
17. Proprietary test equipment required by the manufacturer, whether specified or not, shall be provided by the manufacturer of the equipment. Manufacturer shall provide the test equipment, demonstrate its use, and assist the Test Engineer in the commissioning process. Proprietary test equipment shall become the property of the Owner upon completion of commissioning.
18. Ensure deficiencies found in the Commissioning Issues Log are corrected within the time schedule shown in the Commissioning Plan.
19. Provide Commissioning authority with all submittals, start-up instructions manuals, operating parameters, and other pertinent information related to Commissioning Process. This information shall be routed through Architect.
20. Provide commissioning authority with a certificate of readiness to show systems are ready to schedule functional testing.
21. Prepare and submit to Commissioning authority proposed Training Program outline for each system.
22. Coordinate and provide training of Owner's personnel.
23. Prepare Operation & Maintenance Manuals and As-Built drawings in accordance with specifications; submit copy to Commissioning authority in addition to other contractually required submissions. Revise and resubmit manuals in accordance with Design Professionals and Commissioning authority comments.

24. Commissioning requires participation of this Division Subcontractors to ensure that systems are operating in manner consistent with Contract Documents. All costs associated with the participation of Contractor, Sub-Contractors, Design Professionals, and Equipment Vendors in the Commissioning Process shall be included as part of the Construction Contract.

B. Subcontractors and vendors shall prepare and submit to Commissioning authority proposed Startup procedures to demonstrate proper installation of systems, according to these specifications and checklists prepared by Commissioning authority

1.5 COMMISSIONING PLAN

A. Commissioning Process tasks and activities:

1. Commissioning kick-off meeting: Conducted by commissioning authority and attended by construction team and design team.
2. Pre-functional checklists: Prepared by the commissioning authority and filled out by subcontractors performing the work that is applicable.
3. Site visits to review installation of applicable systems and progress of checklist documentation performed and reported by commissioning authority.
4. Functional testing: Commissioning authority shall conduct functional testing with assistance of applicable subcontractors and document successful results as well as deficiencies (issues). Functional performance testing shall demonstrate the installation and operation of components, systems, and system-to-system interfacing in accordance with plans and specifications. Testing shall include all modes and sequence of operation, including under full-load, part-load and emergency conditions (including all alarms). Controls system shall be tested to document that control devices, components, equipment and systems are calibrated and adjusted and operate in accordance with the plans and specifications. Sequences shall be functionally tested to document they operate in accordance with plans and specifications.
5. Preliminary commissioning report: Commissioning authority shall issue a preliminary commissioning report to the owner that has results of the first round of functional testing including deficiencies discovered.
6. Air and hydronic system balancing: Air and water flow rates shall be measured and adjusted to deliver final flow rates within the tolerances provided in the contract documents. System balancing shall be performed by TAB contractor as specified in 230593 - Testing, Adjusting, And Balancing.
7. Systems manual: Commissioning authority shall compile the systems manual using submittal data provided by the general contractor and applicable subcontractors.
8. Final commissioning report: Commissioning authority shall issue final commissioning report documenting the entire process and final results of functional testing. Report shall include final testing and balancing report.

B. Equipment to be tested

1. Energy Management and Control System:

a. Graphical User Interface
b. Automation Software

c. Field Level Controllers
d. Field Level Devices
e. Control Sequences

2. Chilled Water Systems (All chillers and pumps)
3. Heating Water Systems (All boilers and pumps)
4. Air Handling Systems (All AHU and 10% of terminal units)
5. Energy Recovery Systems (100%)
6. Water Treatment Systems (Verify vendors completion of scope)
7. Service water heating systems (100%)

C. Testing functions and conditions

1. Energy conservation programs (economizer, optimal start, etc.)
2. Verify shutdown of systems when scheduled.
3. Calibration of sensors
4. Testing shall affirm winter and summer design conditions.
5. Test under full outside air conditions.
6. Confirm functionality of all specified sequences of operations.
7. Verify the functionality of all alarms.

D. Performance criteria

1. Air and water temperatures shall be within tolerances specified in the contract documents.
2. Space temperatures shall be maintained within 1 degree of specified set points.
3. Space humidity shall be maintained within 5% of specified levels.

PART 2 - PRODUCTS

2.1 NO PRODUCTS SUPPLIED

PART 3 - EXECUTION

3.1 GENERAL

A. This Division has startup responsibilities and are required to complete sub-systems so COMPLETE SYSTEMS are fully functional. Insuring they meet design requirements of Contract Documents. Commissioning procedures and testing do not relieve or lessen this responsibility or shift this responsibility, in whole or in part, to Commissioning Agent or Owner.

B. Coordinate with other Sub-Contractors and equipment vendors to set aside adequate time to address Pre-Functional Checklists, Functional Performance Tests, Operations & Maintenance Manual creation, Owner Training, and associated coordination meetings.

C. Commissioning authority will also conduct site inspections at critical times and issue Cx Field Reports with observations on installation deficiencies so that they may be issued by Architect as deemed appropriate.

3.2 WORK PRIOR TO COMMISSIONING

A. Complete all phases of the work so the systems can be started, adjusted, balanced, tested, and otherwise tested.

B. See pertinent specification sections in this Division, which outline responsibilities for start-up of equipment with obligations to complete systems, including all sub-systems so that they are fully functional.

C. Assist commissioning authority with all information pertaining to actual equipment and installation as required complete the full commissioning scope.

D. Contractor shall prepare startup procedures to demonstrate compliance with pre-functional checklists, and coordinate scheduling for completion of these checklists.

E. A minimum of 7 days prior to date of system startup, submit to Commissioning authority for review, detailed description of equipment start-up procedures which contractor proposes to perform to demonstrate conformance of systems to specifications and Checklists.

3.3 PARTICIPATION IN COMMISSIONING

A. Attend meetings related to the Commissioning Process; arrange for attendance by personnel and vendors directly involved in the project, prior to testing of their systems.

B. Provide skilled technicians to startup and test all systems, and place systems in complete and fully functioning service in accordance with Contract Documents.

C. Provide skilled technicians, experienced and familiar with systems being commissioned, to assist Commissioning authority in commissioning process.

3.4 WORK TO RESOLVE DEFICIENCIES

A. Complete corrective work in a timely manner to allow expeditious completion of Commissioning Process. If deadlines pass without resolution of identified problems, Owner reserves the right to obtain supplementary services and/or equipment to resolve the problem. Costs thus incurred will be Contractor’s responsibility.

3.5 PRE-FUNCTIONAL CHECKLISTS (PFC)

A. Contractor shall complete Pre-Functional Checklists to validate compliance with Contract Documents installation and start-up requirements, for this Division’s systems.

B. Refer to commissioning plan for detailed list of equipment to be commissioned.

3.6 FUNCTIONAL PERFORMANCE TESTING (FPT)

A. Contractor, in cooperation with Commissioning Agent, shall conduct Functional Performance Testing to validate compliance with Contract Documents.

B. Provide commissioning authority with a certificate of readiness to show systems are ready to schedule functional testing.

C. Refer to commissioning plan for detailed list of equipment to be commissioned.

D. Assist Commissioning authority in Functional Testing by removing equipment covers, opening access panels, etc. Furnish ladders, flashlights, meters, gauges, or other inspection equipment, as necessary.

E. DBR has included a small contingency for limited retesting, however DBR reserves the right to stop testing on a system when the system:

1. Does not have the correct graphics programmed.
2. Does not have the correct data trends programmed.
3. Does not have the correct set points programmed.
4. Does not have the equipment or system safeties installed and programmed correctly.
5. The TAB data forms have not been submitted to our firm or the performance of the system listed on the TAB forms is not per project requirements.
6. Line items of the functional performance test have failed.

F. Sampling

1. Multiple identical pieces of non-life-safety or otherwise non-critical equipment may be functionally tested using a sampling strategy.
2. Significant application differences and significant sequence of operation differences in otherwise identical equipment invalidates their common identity. A small size or capacity difference, alone, does not constitute a difference. It is noted that no sampling by Subs is allowed in pre-functional checklist execution.
3. A common sampling strategy is the “xx% Sampling - yy% Failure Rule,” defined by the following example.

    a. xx = the percentage of the group of identical equipment to be included in each sample.
    b. yy = the percentage of the sample that if failing, will require another sample to be tested.
    c. The example below describes a 20% Sampling - 10% Failure Rule.
    d. Randomly test at least 20% (xx) of each group of identical equipment. In no case test less than three units in each group. This 20%, or three, constitute the “first sample.”
    e. If 10% (yy) of the units in the first sample fail the functional tests, test another 20% of the group (the second sample).
    f. If 10% of the units in the second sample fail, test all remaining units in the whole group.
    g. If at any point, frequent failures are occurring and testing is becoming more troubleshooting than verification, the CxA may stop the testing and require the

responsible Sub to perform and document a checkout of the remaining units, prior to continuing with functionally testing the remaining units.

G. Re-Testing and Failure To Remedy Deficiencies

1. Despite Contractor's best efforts to ensure systems are problem-free, it is expected that some deficiencies will be found during initial inspection of Pre-functional Checklist, and during initial Functional Testing; such deficiencies are expected to be minimal.
2. It is Contractor's responsibility to remedy identified deficiencies, both in Pre-functional Checklist and in Functional Testing phases of work, in a timely and thorough manner.
3. It is Contractor's responsibility to ensure that all deficiencies are corrected prior to requesting a re-inspection or re-test of systems and equipment. Do not request re-inspection or re-test until deficiencies are corrected.

    a. At his discretion, CxA may agree to re-testing systems or equipment where deficiencies remain which are beyond Contractor's control to resolve expeditiously.
    b. Typically such re-testing of incomplete systems and equipment will take place only if remaining deficiencies are minor in scope and nature, and are of such nature that they cannot be resolved in a timely manner (such as those due to difficulties in obtaining parts, or where Owner has requested a change that has delayed work, etc.)

4. CxA will carry out a second re-inspection or re-test of systems and equipment subsequent to receiving Contractor's request.

    a. If CxA finds deficiencies identified in initial inspection or test have not been remedied (with exception of un-resolvable deficiencies in 3.b. above), and such remaining deficiencies are significant enough to require additional inspection or re-testing, Contractor will be back-charged for CxA's expenses, and time at a rate of $150.00 per hour and $100.00 expenses, for a third and any subsequent re-inspections and re-tests.

H. Deferred Testing

1. "Seasonal Commissioning" pertains to testing during peak heating or cooling seasons when HVAC equipment is operating at full-load or heavy-load conditions. Initial commissioning will be done as soon as contract work is completed, regardless of season. Seasonal Commissioning under full- or heavy-load conditions other than the current season will be handled at later time by GC and CxA.
2. If adequate load may be artificially placed upon heating or cooling equipment, CxA, at his discretion, may perform functional testing during non-peak load periods.
3. GC is to provide services of personnel and participate in seasonal testing process in the same manner as he would in non-seasonal testing.
4. Until off-season commissioning can be accomplished, Owner may retain an amount from GC's payment sufficient to cover the cost of off-season testing.
5. Unforeseen Deferred Tests: If any check or test cannot be completed due to building structure, required occupancy condition, or other reason, execution of checklists and functional testing may be delayed upon approval of Owner. Tests shall be conducted in same manner as seasonal tests, as soon as possible. Services of required parties will be

negotiated. Make final adjustments to Operation and Maintenance Manuals and record drawings due to unforeseen deferred tests.

6. GC is to provide services of personnel and participate in deferred testing in the same manner as he would for normal commissioning.

3.7 TRAINING

A. The following requirements are in addition to Operations & Maintenance requirements specified elsewhere in this specifications manual.

B. Contractor shall be responsible for training coordination and scheduling, and ultimately to ensure that training is completed.

C. The training agenda (plan) shall include, at a minimum, the following elements:

1. Purpose of equipment.
2. Principle of how the equipment works.
3. Important parts and assemblies.
4. How the equipment achieves its purpose and necessary operating conditions.
5. Most likely failure modes, causes and corrections.
6. On site demonstration.

D. Commissioning authority shall be responsible for overseeing and approving content and adequacy of training of Owner personnel for all installed systems. Provide Commissioning authority with training plan two weeks before planned training.

3.8 OPERATIONS & MAINTENANCE MANUALS

A. The following requirements are in addition to Operations & Maintenance requirements specified elsewhere in this specifications manual.

B. Sub-Contractor shall compile and prepare documentation for equipment and systems specified in this Division and shall deliver documentation to Contractor for inclusion in Operation & Maintenance Manuals, in accordance with requirements of Division 01, prior to training Owner personnel.

C. Provide Commissioning authority with a single, electronic copy of Operation & Maintenance Manuals for review. Commissioning authority copy of O&M manuals shall be submitted through Architect.

D. Operation and maintenance manuals shall include service agency contact information, maintenance requirements, controls system settings and a narrative of how each system is intended to operate, including set points.

3.9 DOCUMENTATION

A. Commissioning authority shall provide documentation of process as follows:

1. Preliminary commissioning report including test procedures, results of testing, itemization of deficiencies, deferred tests and climatic conditions required for performance of deferred tests. Preliminary commissioning report shall be issued to owner to demonstrate the first pass of testing has occurred and to demonstrate compliance with applicable codes.
2. Final commissioning report shall include the final test and balance report, final results of functional testing, disposition of deficiencies discovered during testing, including the details of corrective measures used and functional testing procedures used for repeatability of testing in the future.

END OF SECTION 230800

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SECTION 230933 - BUILDING MANAGEMENT AND CONTROL SYSTEM

PART 1 - GENERAL

1.1 SCOPE

A. This project consists of Building Management and Control System replacements at the following district facilities: North Hampton Elementary School

B. The control system replacement shall include providing and installing a complete wired Building Management and Control System (BMCS), including industrial instrumentation necessary to obtain functions and results specified. Wireless components are not acceptable. A complete system includes items such as sensors, valve actuators, dampers actuators, DDC panels, relays, terminal equipment controllers, mounting brackets and thermowell, etc. Integrate all components to provide a complete and functioning system.

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 entire Building Management and Control System (BMCS) shall be installed by the Automation System Manufacturer or Authorized Distributor.

   1. All components and elements
   2. The testing and acceptance procedure

G. The manufacturer of the building automation system shall provide documentation supporting compliance with current ISO standards for Quality Assurance. 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.

H. 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.

I. Existing Building Management and Control system points lists are available upon request to the engineer for all facilities.

1.2 RELATED WORK

A. Division 23, Mechanical

1. 230934 BMCS Points Lists
2. 230994 Building Management and Control System - Graphics
3. 23 09 93 Sequence of Operations for Building Management and Control System
4. 01 91 13 and 23 08 00 Commissioning

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.

10. Submit project specific sequence testing procedures for all equipment outlined on drawings and specifications.
    Submit documents in color of the AHU and sensor level area maps.

B. Owner shall have final review and approval prior to start of work.

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 WARRANTY

A. Provide with a manufacturer’s parts and labor warranty for a period of two years from substantial completion. Warranty shall also include unlimited telephone technical support, sequence. Through warranty period and at the end of warranty period firmware, software and front end shall be updated to be the most current version available at no cost to the owner.

PART 2 - PRODUCTS

2.1 PREFERRED MANUFACTURERS

A. Alerton / Tridium by Climatec

B. Automatic Logic by ALC – Houston

C. Unify Energy Solutions – Reliable Controls

2.2 SYSTEM ARCHITECTURE

A. The Building Management and Control System (BMCS) shall capable of both 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 BLN trunk. Systems that limit data exchange to a defined number of system points are not acceptable.

B. The BMCS shall support networking via ethernet or MSTP of the Building Level Network Controllers which includes, Air Handler, and Central Plant control panels. The Field Level Network for terminal equipment shall be a true token-pass peer-to-peer network.

C. Systems Field Level Network 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.

D. The failure of any DDCP on the network shall not affect the operation of other DDCP's and be capable of standalone operation. All DDCP failure shall be annunciated at the specified alarm pages, remote notifications and graphical notification will be represented in color on the front-end building graphic. Provide a table and floor plan graphic page that indicates which controllers are experiencing communication failures.

E. Network ethernet shall support a minimum communications speed of 115.2 Kbps for Air Handlers, and Central Plant equipment.

F. Network shall support an unlimited number of DDC controllers.

G. 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.

H. BacNet instance numbers MUST follow Klein ISD BacNet Instance Number Standards. If BacNet conflicts are created, the contractor is responsible for all costs associated with correcting issues.

I. Provide Klein ISD, at closeout, a list of all BacNet devices IDs and IP addresses used as part of this work.

J. Each system shall be provided with a minimum of one data connection to Klein ISD servers: this data drop, as well as any additional data drops shall be coordinated with the Owner. Cost for all data connections shall be provided by Owner.

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 16 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 industry standard communications ports. 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 (AI) - for measuring sensed variables. Inputs shall be capable of accepting voltage, resistance, current or pressure signals.
2. Analog outputs (AO) - for controlling end devices. Outputs shall be capable of producing voltage, resistance, current or pressure signals.
3. Digital inputs (DI) - for monitoring dry contacts such as relays, switches, pulses, etc.
4. Digital outputs (DO) - to control two position devices such as starters, actuators, relays, lighting contactors, 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. Network communications
9. Manual override monitoring
10. Seven (7) calendar days of operating schedules
11. Stand-alone operation

G. 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.

H. 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 communications port, and via a network workstation PC.

I. 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. 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.

J. Each control panel shall be provided with the either 10% or a minimum of (2) spare I/O

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. 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 sent to via remote notifications.

E. Historical trend data shall be collected and stored at each DDCP for later retrieval. Retrieval shall be manual or automatic and user adjustable to be either manual, automatic or both. 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. Trend and historical data shall be gathered and recorded for a minimum of one year (adjustable) for all trended points (note: Control Companies must confirm that the existing server is capable of storing this quantity of data, and if upgrade is required then this scope shall be included in the costs of the controls project. Digital/binary and analog points and include but not be limited to sensors values, damper position, valve position, and relative humidity. Digital/binary points shall be change of value trend and analog points shall be trended on a 15 minute interval (adjustable per point). Data shall be available to be displayed in a chart form and allow for multiple values to be trended on a single chart. All trends shall be passed through to the front end to be permanently stored.

G. 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.

H. 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.

I. Any invalid operator entry shall result in an error message.

J. DDCP's shall contain a password access routine that will assign an operator to a minimum of three levels of access.

K. 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. System shall allow users to reset totalized values.

L. Provide full access to system at one time for an unlimited number of users without the requirement to purchase additional user access.

M. User Levels and Descriptions

1. General Notes – all system users (including: KISD employees, BMCS Company employees, and Consultants) shall be placed into one of the following defined user levels. Each user shall be required to sign the included user agreement and submit to Klein ISD BMCS Department before approval will be granted.
2. User Levels – the following defined user levels shall be set-up by the BMCS Company as part of this project, with the specific permissions/access defined for each level. Klein ISD Administrators must also be set-up in the system and trained on how to add new users and also how to modify the user level for existing BMCS users (all of this shall take place prior to substantial completion). A change in user level shall be accomplished simply by an Administrator changing the assigned user level for a current user in the system and all rights for the new user level shall be automatically inherited (for example: if a user is already in the system as a Beginning, then changing their user level to an Intermediate would immediately allow them all of the rights of an Intermediate user that they did not previously have as a Beginning).

    a. Administrator – this user level shall have access to ALL parts of the BMCS system, including but not limited to Administrator functions (User Management, Admin Reporting, etc.).
    b. Advanced – this user level shall have access to the same Programming/Tech/Settings pages as the Administrator, but not the Administrator functions described above
    c. Intermediate – this user level shall have similar access to Advanced user level; however, with limitations on the Programming/Tech/Settings pages (this user level shall either have read only access to these pages, if possible, or no access at all). With regard to unit/equipment graphics will have full override capabilities and will be able to schedule all systems (that have scheduling available)
    d. Read Only – this user has read only to system graphics and schedules

3. BMCS Forms – will be provided and managed by Klein ISD.

2.7 ENERGY MANAGEMENT SOFTWARE

A. The BMCS shall be provided with a fully functional optimal start program. This feature shall be user selectable to enable or disable.

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 a global change and demand response feature. This feature shall be user selectable to enable or disable.

1. Global modifications to schedules and setpoints shall be customizable and be accessed and modified from the district, building, zone, wing, pod and classroom level of system.
2. Global modifications shall download throughout the system as priority and shall be accomplish in an orderly and within 10 minutes.
3. System shall continue to download global modifications to the rest of the district even when one campus has lost communication because of a failed panel. System shall notify users of which panel has failed and has not accepted the global modification.
4. Demand response programming shall be integrated into the system to allow owner to facilitate strategies for shedding load in a timely manner.

C. 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.
6. Schedules shall be quickly accessible by no more than two mouse clicks from all graphical pages. Schedules shall incorporate an area for users to add notes for description of event and author names.
7. System shall allow user defined common space group schedule creation and be fully customizable. For example, groups such as all kitchens, all gyms, all athletics, all hallways, etc.
8. System shall incorporate schedule modifications immediately and utilize the new schedule from time of creation.
9. System shall notify user of schedule not downloading and event not occurring as planned.
10. Schedules shall be fully accessible from mobile devices and use a scalable or responsive technology to provide full capabilities and functionality that is provided with the desktop software. Refer to Web Server requirements for mobile devices.
11. System shall include priority level schedules in a hierarchy configuration.

    a. Emergency Off highest priority (Freeze condition)
    b. Override 2nd highest priority (Special Event Schedules)
    c. Holiday 3rd highest priority (Spring Break, Thanksgiving, Christmas)
    d. Normal 4th highest priority (Regular school hours)

D. 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. Static pressure reset.
7. Dead band control. Install dual set points as requested by user.
8. 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.

E. Software shall include an energy management analysis tool which will provide the users the ability to analyze, compare and normalize building energy consumption on a day, week, month and year time interval.

F. Software shall poll local airports and other facility BMCS systems for ambient temperature and humidity valves. These values shall be compared to the readings at each campus and send an alarm to the system that a building temperature and humidity sensor has failed if the building values are 5 ˚F or 5% R.H. above or below (adjustable).

2.8 BUILDING MANAGEMENT EDITING SOFTWARE

A. Provide (5) five fully functioning copies of all software required for modifications to graphics, databases, programming, points, etc. Software shall include all user licenses for an unlimited number of years and/or renewals. Additionally, any back-up Tridium JACE units shall be equipped with temporary licensing in order to accommodate out of warranty emergency failures.

B. Software shall be provided with both local and remote access via a remote desktop application.

2.9 WEB SERVER ACCESSIBILITY

A. Industry leading encryption technology to provide accessibility through any web browser software including but not limited to Apple's Safari, Microsoft Internet Explorer, Google Chrome and Mozilla Firefox.

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

C. Building Manager's access must be compatible with a wide range of mobile device platforms including but not limited to Apple IOS, Android, and Microsoft Windows. Mobile access shall match features and abilities available via a desktop computer browser.

2.10 REMOTE NOTIFICATION AND ALARMS

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. System shall contain priority notification tree. Coordinate with owner for required points to be set to provide remote notifications.

1. Email
2. Cell phones via text messages.
3. Phones via voice message.

B. Refer to Section 230934 for additional requirements related to this article.

2.11 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 cable or ethernet.
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.

2.12 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. Heat Pumps
6. Unit Ventilators
7. Room Pressurization
8. Fan Coil Units
9. Multi-zone Units

B. Terminal unit controllers and damper actuators shall be separate and individually replaceable.

C. Include the following items:

1. All input and outputs necessary to perform the specified control sequences.

    a. Analog outputs shall be industry standard signals.

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.
8. The failure of any terminal equipment controllers on the network shall not affect the operation of other terminal equipment controllers and be capable of standalone operation. All terminal equipment controller failures shall be annunciated at the specified alarm pages.

2.13 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 100%
3. Minimum torque 100 in-lb.
4. Actuator shall fail in place.

C. Damper actuators shall not have integral controllers.

D. Outside air dampers shall be interlocked such that damper operates with the starter or VFD in hand or auto. The damper end switch shall energize the unit to run only with end switch for fully open is signaled.

E. Provide damper actuators to match the existing damper actuators. District will not accept and MFT model Belimo Actuators.

2.14 CONTROL CABINETS

A. Fully enclosed NEMA 1 for indoors, NEMA 4 for outdoors, NEMA 4X for Natatorium Applications.

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. 802 or 751 are the accepted key types.
5. Cabinets shall be provided with adequate depth to house all components.
6. Panels or termination panels must be identified with engraved nameplates.
7. Provide enamel finish and extruded aluminum alloy frame UL 50 certified.
8. Provide only 100VA Transformers with integral manual overload reset and a motor rated switch installed on the 120V side for disconnecting means per NEC.

B. Above each control cabinet provide a wire gutter that matches the width of the control cabinet. All control wiring shall pass through this wiring gutter. Provide each wire with a 3 foot long service loop located in wiring gutter.

C. Each control panel that is directly connected to KISD network shall be connected to the emergency power for the facility.

D. Each Air Handling unit shall be provided with a dedicated control transformer. Ensure all safeties related to each air handler are associated with the dedicated control transformer.

2.15 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.
4. Pressure Independent Control Valves (PICV) shall not be utilized.
5. All air handling units shall be provided with globe valves on both chilled and hot water coils. Ball valves are not acceptable for air handling units.
6. All valves shall be configured from the factory in the open position thus requiring valve to be driven closed.

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: In general, actuator manufacturer shall match the existing valve manufacture (any exceptions shall be pre-approved by the Owner. Where valves are being replaced with new, provide actuator to match new valve manufacturer.

1. Direct coupled installation
2. Visual and electronic stroke indicator
3. Die-cast aluminum housing
4. Manual override without disconnecting power
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. 0-10 VAC (any 4-20mA must be pre-approved by the Owner) 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 150%.
14. Actuator input signal shall be compatible with output DDC controller.
15. Provide U.V. resistant material weatherproof metal actuator enclosure for exterior locations.
16. Damper actuators not acceptable for valves.
17. All 120V actuators shall be provided with a motor rated switch for disconnecting means. Exterior switches shall be provided with a NEMA 4X enclosure.

G. Chilled Water By-Pass Valve:

1. Confirm the selection of any needed Chilled Water By-Pass Valves with the Owner prior to installation.
2. Maximum pressure drop: 5 psi
3. Sized for minimum flow of one chiller as scheduled.
4. Torque to exceed the maximum required operating torque by not less than 150%.

2.16 FLOW SWITCHES

A. Wetter parts made of type 316 stainless steel.

1. Designed for mounting in pipe tee.
2. Watertight, dust-tight, and corrosion resistant enclosure.
3. Paddle shall be factory fabricated to accommodate pipe sizes used.
4. Switching action shall be single pole double throw.

B. Approved manufacturer:

1. ITT McDonald Miller #FS7-4WL for piping over 8", FS7-4W for chilled water: or equivalent.
2. ITT McDonald Miller #FS7-4L for piping over 8", FS7-4 for hot and condenser water: or equivalent.

C. Remote Flow Solid-State Flow Detection:

1. Extended length flow probe
2. Cabinet-mounted control monitor
3. Wetted parts, 316 stainless steel probe
4. Optional temperature and wire-break outputs
5. Flow and temperature switch points
6. LED bar graph display for status indication

D. Approved Manufacturer:

1. IFM Effector

2.17 TEMPERATURE LOW LIMIT SWITCH

A. Responsive to the coldest 1' section of its length.
   1. Double pole single throw switch
   2. 20' capillary installed with coil clips. Similar metals only.
   3. Line voltage with bellows actuated switch
   4. Manual reset
   5. Refer to manufacturer’s installation instructions for installation locations with limited duct access. Support material shall be rigid copper pipe or coil clips.

2.18 TEMPERATURE AND HUMIDITY SENSORS

A. Calibration for all sensors shall be provided and shall be accessible directly from the front end GUI (Graphical User Interface)

B. Space Temperature Sensors

1. Thermistor with resistance of 10,000 ohms at 77°F.
2. Accuracy shall be +/-1/2°F.
3. Range of 55° to 95° F.
4. Provide manufacturers calibration certificate.
5. Front covers without displays throughout the building.
6. Ventilation ring for fast response
7. Jack at sensor for communications
8. Location and height to be approved by Engineer prior to installation
9. Color to be approved by Engineer/Owner. Submit a sample to reviewed by owner. Acceptance of sample shall be in writing to contractor.
10. Provide ventilated locking clear plastic guards in the following locations:

    a. Cafeteria
    b. Kitchen/Serving Lines
    c. Gymnasium
    d. Dressing/Locker Rooms/Weight Rooms
    e. Industrial Labs

11. Provide an insulated sensor wall plate to fully cover wall opening. Back cover plate shall match sensor color.
12. Where indicated on drawings to provide both space temperature and space humidity, a combination temperature sensor shall be used but device shall still comply with characteristics described in each section of specification.

C. 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. Accuracy shall be +/-2% in the range from 20 to 95% RH.
3. Relative humidity sensors shall have the sensing element of inorganic resistance media.
4. Provide manufacturers calibration certificate.
5. Provide ventilated locking metal guards in the following locations:

    a. Cafeteria
    b. Kitchen/Serving Lines
    c. Gymnasium
    d. Dressing/Locker Rooms/Weight Rooms
    e. Industrial Labs

6. Provide an insulated sensor wall plate to fully cover wall opening. Back cover plate shall match sensor color.

7. Where indicated on drawings to provide both space temperature and space humidity, a combination temperature sensor shall be used but device shall still comply with characteristics described in each section of specification.

D. Duct Temperature Sensors (Averaging Probes)

1. Range of 20° to 120°F.
2. Multi point sensing of temperature.
3. Averaging elements of sufficient length to sense temperature across the full face of the coil or 2/3 duct width, provide accurate, representative indication and control and prevent variances in temperature or stratification.
4. Probes with lengths greater than 3’ shall be externally supported to adjacent structures to prevent unwanted movement.
5. BAPI Rigid Averaging Temperature Sensor with steel junction box. (Note provided sensor shall satisfy the requirement to extend 2/3 across the entire airflow being measured.)

E. Liquid Immersion Temperature Sensors

1. Platinum type resistance temperature detector (RTD).
2. Match sensor range to medium being monitored.

    a. Range 30° to 250°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.

F. 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 sum 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. Acceptable Manufacturer

    a. ACI Model # A/-RH2-AN-O-SUN---NIST
    b. Belimo 22UTH-530X-NIST

2.19 CURRENT SWITCH

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.
    4. Loop powered.
    5. LED Status.
    6. Relays shall close status contacts in response to current flow in power leads to the equipment being monitored.
    7. Acceptable Manufacturer: Veris Industries / Hawkeye Veris Hawkeye H608 Current Switch for AHUs, Pumps, Cooling Tower Fans and any other equipment with non-fractional HP motors.

2.20 CURRENT TRANSDUCER

A. Ensure compatibility with VFD and ECM applications for variable speed motor status and current.
    1. Provide with adjustable set point capable of reading lowest required amperage.
    2. The current sensor shall be a split core type with self-gripping iris that adheres to the electrical conductor.
    3. Provide split-core type.
    4. Loop powered.
    5. The current sensor shall be fixed 0-10A and output of 0-10 VDC.
    5. LED Status.
    6. Transducer shall provide a current reading to BMCS
    7. Acceptable Manufacturer: Veris Hawkeye H623-10 Current Transducer for all CVBs, EFs, SFs, and any other equipment with fractional HP motors.

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. LCD Display. Display shall be mounted at 5’-6” above finished floor.
5. Sensor leads shall be routed in conduit from transducer to display location.
6. Acceptable Manufacturer: Veris PWRLX04S020A

2.22 ELECTRIC REMOTE BULB THERMOSTAT

A. Two position outdoors rated 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.

2.23 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.

2.24 HIGH STATIC PRESSURE SWITCH

A. With manual reset switch

1. Approved manufacturer: Cleveland AFS-460 or approved equal.

B. Provide with pitot tube in airstream and route polytube in conduit to remote sensor mounted on wall at 5’-6” above finished floor.

2.25 INSERTION FLOW SENSORS

A. Electromagnetic Flow Meter
   1. Retractable hot tap flow sensor

2. Accuracy: +/- 1% of full scale
3. Custom thread-o-let 400 psi / 250°F rated
4. Installed into a 1” full port ball valve
5. Provided with an insertion depth gage
6. Line size from 2-1/2 to 72 inches
7. Metering range from 0.1 to 20 f/sec (200:1 turndown).
8. Remote NEMA 4 wall mounted LCD display. Mounted on wall at 5’-6” above finished floor.
9. Field Pro Software & Communicator
10. Warranty two years
11. Approved Manufacturer: Onicon Electromagnetic Flow Meter F-3500 Series

2.26 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, sinthered 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.

2.27 WATER LEAK DETECTOR SWITCH

A. Rated at 10 Amps.
1. Shuts off equipment if water level becomes too high.
2. DPDT Contacts.
3. Dwyer # WD3-LP-D2

2.28 BY-PASS AUTOMATIC SHUT-OFF TIMERS - INTERIOR

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

2.29 2.29 BY-PASS AUTOMATIC SHUT-OFF TIMERS - EXTERIOR

A. Voltage as required by BMCS system.
1. Shuts off equipment with timed switch
2. Stainless steel decorated timer
3. Without hold feature
4. Time Cycle 120 minutes with UV resistant time labels.
5. Installed in a weatherproof clear plastic enclosure.

2.30 HVAC SHUTDOWN STATION

A. Shutdown Switch:
1. White background with Red Mushroom Button within a clear plastic cover
2. Latches when depressed
3. Twist reset
4. Sign “HVAC SHUTDOWN”
5. Manufactured by STI Model # SS2331HV-EN

2.31 EXTERIOR LIGHTING OVERIDE STATION

A. Override Button:
1. Yellow background with a Red Mushroom Button within a clear plastic cover
2. Momentary contact configuration
3. Sign “EXTERIOR LIGHTING OVERIDE”
4. Manufactured by STI Model # SS2234ZA-EN

2.32 PITOT TUBES

A. Duct static pressure and high static sensors shall utilize insertion type pitot tubes.
1. Tube shall be rigid metal with 90 degree elbow allowing the tip of the tube to be oriented into the air stream.
2. Product shall be provided with a duct collar and mounting holes.

2.33 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 and factory startup.

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 filtometer
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. Three stage alarms for each point
4. Flow loss and malfunction indicators
5. Individual relay contacts for each set of channel alarms.
6. Infrared detection

E. Alarming and Display:
1. Digital display in PPM/PERCENTAGE
2. Provide a 0-10V and 4-20mAmp 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 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. A clearly identified switch of the break-glass type shall be provided immediately adjacent to and outside of each refrigeration machinery room exit. Upon completion of controls replacement project all non-garage doors shall be equipped with devices as described above.

H. Acceptable manufacturers:
1. Honeywell – Vulcain 301EM-20
2. Approved equal

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 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 burner upon loss of power to the detector.

B. Carbon Monoxide Sensor with two year warranty by U.S. Draft Co. Model CGM-505 with model XB expansion module or equivalent by International Gas Detectors (IGD)
   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 shall include the following:
   1. Remove all existing control devices and replace with new.
   2. Remove all existing wiring and replace with new.
   3. Remove and replace all existing damper actuators on exhaust fans that are existing to remain.
   4. Remove and replace all terminal unit controllers on all equipment that is existing to remain.
   5. Remove and replace all existing BMCS control cabinets.
   6. Existing control conduits may be reused where not damaged or aged. Existing conduit shall be extended to new end device locations. All existing control conduit being abandoned shall be removed.
   7. New control wiring shall not be routed in the same conduit or pathway as any line voltage wiring.
   8. The owner shall be given first right of refusal on all existing control devices.
   9. The existing control valve and control valve actuators on Air Handling Units that are being relocated will be removed, tagged and stored with existing equipment. BMCS contractor shall coordinate with mechanical contractor to ensure valves and actuators are not damaged or misplaced. Upon reinstallation BMCS contractor shall verify proper operation of control valves. If valve or actuator is noted to be damaged or not functioning properly, notify the engineer/owner immediately.
   10. Line voltage wiring shall not be installed within controls cabinet. If line voltage is required a relay should be mounted in a separate enclosure.

B. The new BMCS system shall maintain control of all equipment and devices currently on the existing BMCS system. Contractor shall field verify all existing equipment and devices prior to bid.

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.

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.

3.2 NEW SERVER REQUIREMENTS

A. Provide all servers required for front new building management and control system.

B. Server work shall include all costs associated with building and licensing virtual servers on Klein ISD equipment.

3.3 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 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 changes, 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.

3.4 GRAPHICS

A. The items here within and all items included in specification section 230994 are part of the graphics scope.

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. Provide electronic copy of as-built record drawings, submittals and closeout documents on thumb drive.

C. Provide a set of the "as installed" diagram(s) for each control panel system laminated in plastic and hung on the panel door or as directed by Owner. Laminated sheets shall be bound by a stainless steel cable key ring loop and hung on the panel door by a self-adhesive hook.

D. Provide a two color-coded floor plan of the building, one representative of the AHU level zones and the other to be representative of the space/temperature sensor level and shall indicate the location of each system, the area served by each AHU and each related zone. Provide both in PDF format and in printed form of professional quality. Printed floor plan is to hang in main mechanical room near central control panel.

E. Provide final graphic room numbers as selected by District.

F. All as built documentation including documents listed above shall be uploaded to the BMCS system and be accessible through the graphical pages. Final location of document link to be verified with district.

3.5 IDENTIFICATION

A. General Requirements for Identification and Labeling:
1. Prior to the execution of any label creation or field labeling, contractor shall provide Klein ISD with samples of each label described here within for approval.
2. Coordinate all label nomenclature with the nomenclature shown on the "as installed" control diagrams.
3. All identification and labeling described shall be completed prior to point checkout and startup. Label description shall be part of point checkout process.
4. As applicable, controls contractor shall verify all renumbering of equipment is complete and accurate. If discrepancies are identified, notify Architect, CX Agent
and Engineer.
5. All labeling text shall be type written with a minimum font size so they may be read easily from the ground level. Handwritten labels or handwriting on devices is not acceptable.
6. All labels shall be visible and legible from the normal access side of the equipment or control cabinet without the need for a ladder or other means of access.
7. All labels shall be fully adhered to the end devices. Labels that are not fully adhered throughout the warranty period shall be replaced by the Contractor.
8. Where applicable, existing handwritten equipment numbering that do not

correspond with the final equipment numbering shall be removed by this Contractor or their subcontractor.

B. Equipment and Control Panels Labels:
   9. Provide a phenolic engraved nameplate with black background with white lettering on all mechanical equipment and control panels.
   10. Identifying nameplates shall be secured to each piece mechanical equipment, each main control cabinet, and each control panel with adhesive backing.
   11. Identifying nameplates shall have minimum of ½ inch high, engraved letters. Height shall be adjusted to use larger text as needed to ensure they can be identified from the ground level.

C. Ceiling Labels:
   1. Provide an identification label with a black background with white text.
   2. Provide a label affixed to the ceiling grid below all terminal units, exhaust fans, fan coil unit, hot water coil, and duct static pressure sensors and labeled with the unit tag.

D. Actuators and Multi-Zone Labels:
   1. Provide an identification label with a black background and white text on each actuator, control valve and damper actuator.
   2. Labels shall include air handling unit/equipment number, zone number, and room number. Label material shall utilize a black background with white typed lettering. Coordinate labeling with nomenclature used on the diagrams. For example, Multizone (AHU-X, Zone X, Room X).

E. Space Sensor Labels:
   1. Provide an identification label with a black background and white text on each end device and sensor.
   2. Provide each space temperature and humidity sensors with label located on the inside and outside of sensor cover (exact size, type and locations shall be coordinated in advance with the Owner).
   3. The label shall indicate which device sensor is controlling. If multiple sensors control a single device the sensors shall be labeled with an “A” or “B” etc.
   4. Coordinate labeling with nomenclature used on the diagrams. For example, Multizone (AHU-X, Zone X), VAV (AHU-X, CVB-X), HWC (AHU-X, HWC-X).

F. Electrical Equipment Labels:
   1. Provide an identification label with a black background and white text on each transformer and relay.
   2. The label shall indicate which device they serve and their function.

G. Wire Labels:
   1. Provide slip tags or flag style tags on each wire used for this system. Labels shall be affixed to both ends of the wire. Text shall be type written, handwritten labels or handwriting on wiring is not acceptable.
   2. All wiring within a control panel, including communication and power wiring, must be labeled with either slip tags or flag style tags.
   3. Wiring labels at VAV/CVB boxes shall include all wiring entering and exiting the VAV box control box with a description of where it is coming from and

where it is going to. For example, “From VAV-1-3. To VAV-1-4”. This shall include all communication wiring and all field device wiring.

4. Wiring labels at AHUs and FCUs shall include all wires entering and exiting the field controller with a description of where it is coming from and where it is going to. For example, “From AHU-1. To Control Panel in Mech 350”.This shall include all communication wiring and all field device wiring.

H. Lighting Contactor Labels:
1. Provide an identification label with a black background and white text on each lighting contactor.
2. Labels shall include panel and circuit number serving contactor and the type and location of lights being served by contactor. (i.e. Bus Drop off Canopy).

I. End Devices Labels:
1. Provide an identification label with a black background and white text on each end device and sensor.
2. Identifying labels shall be secured to each end device with adhesive backing.
3. Labels shall include the function of the sensor (i.e. Leaving Air Temperature Sensor – AHU-1).

J. Valve Labels:
1. Provide each campus with twelve (12) red with white lettering laminated plastic engraved tags with the words “VALVE SHALL REMAIN CLOSED”, ½ inch high, engraved letters.
2. Each tag shall be provided with a hole on the top corners of the tag and fitted with an adequate piece of brass "S" hooks or brass chain to allow sign to be hung from valve operator.
3. The butterfly valve utilized for the Chilled Water Pump Manual Bypass Pipe shall be provided with a metal tag with stamped text and chain hanger. Coordinate text requirement with owner.

3.6 WIRING FOR BUILDING MANAGEMENT AND CONTROL SYSTEMS

A. Prior to the start of any work, controls contractor and wiring subcontractor shall schedule a meeting with the owner and engineer to walk the site to discuss wiring system. Contractor shall provide a 7 day advanced notice of the requested meeting date.

B. Furnish and install all wire, conduit, raceways and cable systems required for the complete operation of the Building Management and Control System.

C. 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.

D. All materials and methods specified in this section shall comply with the requirements specified in Division 26 of this specification.

E. 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.

F. 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.

G. All line voltage control wiring, all low voltage control wiring which is in areas without ceilings and exposed to the occupied space in the central plant, mechanical rooms, penthouse, and other similar spaces; all low voltage control wiring which is routed through concealed inaccessible locations shall be installed in conduit.

H. 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’ center minimum. Install wire parallel or perpendicular to the structural features of the building.

I. Line and low voltage control wiring shall not be installed in the same conduit.

J. All wiring associated with building management and control system cover shall be as follows:
   1. Sensor jacket color, Green
   2. Room Temperature and Humidity Sensor jacket color, Green, provide a minimum of 20 gauge wire with 4 conductors.
   3. Ethernet Communications, Cable: Berk-Tek LANmark-6 (11049196) Pink, Jack: 6110-RB6 Brown, Patch cord: 7Ft cat 6 patch cord pink (CDW# 3074351).
   4. All THHN wiring shall comply with Division 26 insulation color identification
   5. Terminal Equipment Controller communications twisted pair, Orange with blue tracer.

K. All wiring, not installed within conduits or boxes, shall be fully supported by D-rings. Wiring shall only touch D-rings and not touch any other building component.

L. All wiring entry and exit points through conduit shall be protected by non-abrasive sleeves or bushings at the open end of conduits.

3.7 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 physically 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 are wired 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., transformers, power supply, etc.). Verify that these devices are installed and wired 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 and is in the correct location, and is wired 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, etc.). Also verify that these auxiliary devices are mounted in the correct location, and are wired 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 ensure that all network terminals, host console devices, etc. can also command these outputs.

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 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.
   g. Setup and verify all remote notification alarms.
   h. Setup and verify all trending.
8. Server/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.
   f. Verify there are adequate user licenses for both online and offline accounts.
9. All actuators shall be marked with direction of rotation upon system startup.
10. Provide a check out list which indicated each point has been tested as previously described. The list shall be signed and dated by person who performed testing.

3.8 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 dated documentation of all tests and verifications as specified.
7. Provide dated 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.
10. Provide PID loop demonstration to owner and provide PID loop tuning if demonstration shows tuning is not within an acceptable range to owner.

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.

3.9 TRAINING

A. All district training needs will be arranged by Klein ISD separate from this project scope of work.

3.10 PROJECT MANAGEMENT

A. Provide a designated project manager with a minimum of 5 years' experience in the related field 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 and 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 230933

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SECTION 230993 - BUILDING MANAGEMENT AND CONTROL SYSTEM – SEQUENCE OF OPERATIONS

CONTENTS

INTRODUCTION

Current Project

This document version includes updates for the following facilities.

- Hildebrandt Intermediate School (HIS)
- Northampton Elementary School (NES)
- Doerre Intermediate School (DIS) 2023 Renovation
- Kleb Intermediate School (KIS) 2023 Renovation

Past Projects

Previous versions of this document have been applied to the following schools prior to this document being issued.

School / Facility	Version
1. Krimmel Intermediate School	0.9

Future Revisions

- As needed based for newly encountered equipment & systems
- As needed for Energy Management and M&O programs

How To Apply This Document

The intent of the document is to provide specific instruction for the programming of the BMCS for Klein Independent School District as well as a basis for standardization going forward as more buildings receive BMCS upgrades and/or significant HVAC upgrades are made, retro-commissioning projects, and new schools are constructed. The subcontractors using this document are advised to read ALL the applicable sections of the document carefully, not just the Detailed Sequences, as the other sections include important functionality descriptions and definitions that are considered as important as the Detailed Sequences.

This document contains much information that may or may not be applicable to any specific facility or project, therefore subcontractors are also advised to read the Detailed Sequences carefully and program only the written sequences that apply to the specific project. To aid the subcontractor in identifying the applicable portions of this document, the Engineer shall provide a Sequence Coordination Table as part of the Design Documents. An example Sequence Coordination Table is provided below as a guide.

Diagrams and screen shots are provided throughout the document for the purpose of clarification and may not include all components and/or elements specified elsewhere and/or in this document. For example, some screen shots developed during

previous revisions of this document may remain and may not include all functional elements specified in the current version of this document.

It is intended that applicable portions of this document be used by the subcontractor for shop drawing purposes and may be copied for inclusion in subcontractor's shop drawing submittal. Likewise, applicable portions of this document may be copied for the purpose of inclusion in GUI sequence pages, or any project-related use.

This document is not intended to be applied to buildings outside of the Klein Independent School District without necessary modifications to account for differing requirements and/or climatic conditions. Where this document differs from any state or local ordinance or code or other site-specific engineer-specified requirement, the more stringent requirement shall govern.

Sequence Coordination Table EXAMPLE ONLY

Katy JH Systems, Sequences, Points, and Interlocks Coordination Table

Group 1: Zoned HVAC Systems	Type	Sequence[1]	Sequence Notes	Points List[2]	Hardwired Interlock[3]	Software Interlock[4]
MZU-1,2,3,4,5,6,7,8	MZU	1.2.1	OA from CV OAHU equipment, no OA Damper	*See Design Drawings*	NA	Occ Schedule, HVAC Shutdown Switch
AHU-9,10,11,13,16 (prev. AHU-1,2,3,5,8)	SZU	1.1.1, 2.1.2	OA Damper follows 2.1.2, 2-pos. OA Damper (no process variable control)	*See Design Drawings*	NA	Occ Schedule, HVAC Shutdown Switch
AHU-12,15,23 (prev. AHU-4,7,A)	SZU	1.1.1, 2.1.2	:: AHU has two (2) OA dampers, Min OA Damper & Max OA Damper, and an RA Damper :: Min OA Damper follows 2.1.2 2-Pos. OA Damper (no process variable control) :: Max OA Damper follows 2.1.2 Modulating OA/RA Damper (with process variable control), process variable is CO2 & Economizer	*See Design Drawings*	NA	Occ Schedule, HVAC Shutdown Switch
AHU-14 (prev. AHU-6)	SZU	1.1.1, 2.1.2	:: AHU-14 serves the Kitchen and has two (2) OA dampers, Min OA Damper & Max OA Damper, and an RA Damper :: Min OA Damper follows 2.1.2, 2-Pos. OA Damper (no process variable control) :: Max OA & RA Damper follows 2.1.2, 2-Pos. OA Damper interlocked with kitchen hood operation	*See Design Drawings*	NA	Occ Schedule, HVAC Shutdown Switch
AHU-17,18,19,22 (prev. AHU-9,10,11,14)	SZU	1.1.1	OA from CV OAHU equipment, no OA Damper	*See Design Drawings*	NA	Occ Schedule, HVAC Shutdown Switch
AHU-20,21 (prev. AHU-12,12A)	SZU	1.1.1, 2.1.2	:: Incl. Staged DX Coil and Staged Elec. Heat and Manual Override Button on T-stat :: OA Damper follows 2.1.2, 2-pos. OA Damper (no process variable control)	*See Design Drawings*	NA	Occ Schedule, HVAC Shutdown Switch
FCU-2,3	SZU	1.1.1	OA from CV OAHU equipment, no OA Damper	*See Design Drawings*	NA	Occ Schedule, HVAC Shutdown Switch
RTU-1	SZU	1.1.1	Packaged DX w/ HGR, Gas Heat	*See Design Drawings*	NA	Occ Schedule, HVAC Shutdown Switch
Group 2: Fresh Air & Exhaust Systems	**Type**	**Sequence[1]**	**Sequence Notes**	**Points List[2]**	**Hardwired Interlock[3]**	**Software Interlock[4]**
OAHU-1,2,3,4,5,6 (prev. PTAHU-1,2,3,4,5, OAU-1)	OAHU	2.1.1	All are CV OAHU's	*See Design Drawings*	OA Damper, Freeze Stat	Associated AHU, Bldg Vent Schedule, HVAC Shutdown Switch
FCU-1	OAHU	2.1.1	CV OAHU	*See Design Drawings*	OA Damper, Freeze Stat	Associated AHU, Bldg Vent Schedule, HVAC Shutdown Switch
EF-1,2,4,11,12,13,14,15	General Exhaust	2.2.1	none	*See Design Drawings*	OA Damper	Associated OA Source (OAHU, OASF, AHU OA Damper), Bldg Vent Schedule, HVAC Shutdown Switch
EF-3	Home Ec	2.2.3	none	*See Design Drawings*	Timer Switch	NA
EF-19	Range	2.2.3	none	*See Design Drawings*	Timer Switch	NA
EF-5,6,7,17	Kitchen Hood	2.3.1	none	*See Design Drawings*	SF-2,3,4,6	NA
EF-8	Dishwasher	2.2.3	none	*See Design Drawings*	Dishwasher	NA
EF-10	Kiln	2.2.2	none	*See Design Drawings*	SF-5	NA
EF-16	Fume Hood	2.2.3	none	*See Design Drawings*	Wall Switch	NA
EF-17	Kitchen Hood	2.3.1	none	*See Design Drawings*	SF-6	NA
SF-2,3,4,6	Kitchen Hood MAU	2.3.1, 2.1.1	none	*See Design Drawings*	Wall Switch	NA
SF-5	Kiln	2.3.1	none	*See Design Drawings*	EF-10	NA
Group 3: Central Plant Systems	**Type**	**Sequence[1]**	**Special Notes**	**Points List[2]**	**Hardwired Interlock[3]**	**Software Interlock[4]**
Chiller Plant	Chiller Plant Type 1A	3.1.1A	none	*See Design Drawings*	NA	Call for Cooling, Freeze Prevention, Freeze Protection
Boiler Plant	Boiler Plant Type 1	3.2.1	none	*See Design Drawings*	NA	Call for Heating, Freeze Prevention, Freeze Protection
Group 4: Lighting Control Systems	**Type**	**Sequence[1]**	**Special Notes**	**Points List[2]**	**Hardwired Interlock[3]**	**Software Interlock[4]**
Exterior Lighting	Parking Lot, Canopy, Wall Packs, Marquee	4.1	none	*See Design Drawings*	TLO momentary switch located in Main Office (indirect)	TOD Schedule, Daylight Schedule, TLO
Interior Lighting	NA	NA	none	NA	NA	NA
Group 5: Miscellaneous Systems	**Type**	**Sequence[1]**	**Special Notes**	**Points List[2]**	**Hardwired Interlock[3]**	**Software Interlock[4]**
Walk-in Coolers and Feezers	Typical	5.1	none	*See Design Drawings*	NA	NA
HVAC Shutdown Switch	Typical	5.2	none	*See Design Drawings*	Switch located in Main Office (indirect)	NA

NOTES

1. The number listed indicates sequence specification section that includes detailed sequence of operation instructions for the specific equipment type listed. All sequence specification sections that apply to the project may not be listed here. The programmer should read and include applicable functionality from associated sections that are not listed here, including but not necessarily limited to Introduction, Definitions, General, etc. sections. The sequence should be used with the detailed drawings, point lists, and graphical specifications to include all programming and configuration necessary to fulfill the functionality requirements.

2. The number listed indicates the point list specification section that applies to each system type. The point list is intended to include primarily physical points and I/O and associated alarming requirements. All point list specification sections that apply to the project may not be included here. The point list should be used with the detailed drawings, sequences, and graphical specifications to include all points necessary to fulfill the functionality requirements.

3. General hardwired interlocks that apply to the scope of this project are listed in the table. Refer to applicable equipment schedules and the sequence of operations for more detailed interlock information. Required life-safety interlocks such as fire/smoke interlocks are not listed here.

4. General enable/disable software interlocks that apply to this project are listed here, the list may not include all software interlocks required to achieve required functionality. Refer to the sequence of operations for more detailed software interlock information.

Commissioning Using This Document

The Commissioning Agent should become familiar with this document in its entirety to ensure that all applicable sections are applied. For example, the sections that are placed with (usually ahead of) the Detailed Sequences are as important to understand and check as the Detailed Sequences under each section. Pre-functional and Functional testing scripts should be created using the applicable Detailed Sequence along with any applicable functionality detailed elsewhere in the document.

Detailed sequences should be repeated verbatim on the GUI Sequence Page for each applicable unit or system. It is important for the Cx Agent to check these pages for accuracy and use them during Functional Testing to ensure that all adjustable variables and displayed variables are correctly mapped and functional.

Document Organization

The document is organized into groups of systems as follows:

GROUP 1 – ZONED AIR CONDITIONING & HEATING SYSTEMS

GROUP 2 – FRESH AIR AND EXHAUST SYSTEMS

GROUP 3 – CENTRAL PLANT SYSTEMS

GROUP 4 – LIGHTING SYSTEMS

GROUP 5 – MISCELLANEOUS SYSTEMS

Within each group, specific instructions are provided for each type of system encountered within that group, starting with general information and/or instruction and moving to more detailed and sometimes site-specific information and instruction. In cases where the level of detail necessary to achieve meaningful standardization warrants more detailed instruction, a Detailed Sequence is provided that includes very specific instruction as to how specific components within the system are to be controlled.

Sequence of Operations Goals and Guiding Principles

This document is a tactical part of the effort to achieve and maintain the following goal:

Provide the best possible learning and teaching environment while exercising good stewardship of resources.

The following guiding principles of operation and associated strategies have been used to develop the sequences contained herein:

- Avoid simultaneous heat/cool whenever possible.
    - Ample separation between space cooling setpoint and heating setpoint. The following default values shall serve as a general guideline unless otherwise noted or directed by the Owner. NOTE: All the below shall be adjustable by the operator with a minimum offset (CSP – HSP) of 3°F (adj) imposed automatically by the BMCS

- Classroom/Office/General Instructional Areas CSP-HSP>/=5°F (adj), Adjustable Defaults: CSP=74, HSP=69
- Gymnasiums/Auditoriums/Cafeterias (large gathering areas generally occupied for extended periods) CSP-HSP>/=6°F (adj). Adjustable Defaults: CSP=74°F, HSP=68°F
- Commons/Corridors/Vestibules (pass-through areas not continuously occupied for more than a few minutes) CSP-HSP>/=7°F (adj). Adjustable Defaults: CSP=75°F, HSP = 68°F

  - AHU operating modes that segregate the heating and cooling processes
  - Minimize primary air flow / increase primary air temperature through terminal reheat coils when possible.
  - Allow HW system to circulate on call for heat by any reheat coil to allow stored heat to be pulled out of the HW loop but do not start boilers unless indoor air temperatures indicate a need to provide added heat, or if called for by a preheat coil due to very low ambient temperatures.
- Minimize CHW flow requirements by maximizing chilled water delta-T
  - Chilled water coil leaving air temperature setpoints >/= design at all times.
  - Chilled water coil leaving air temperature reset upward whenever possible.
  - Alarm (Low Priority) whenever any chilled water coil discharge air temperature < 50F for an extended period (failed actuator, valve seat failure, etc.), make appropriate repairs immediately.
- Operate equipment within its design limits.
  - Dewpoint-based dehumidification as opposed to relative-humidity-based.
  - Eliminate CHW coil leaving air temperature setpoints below design.
- Stable and repeatable operation over a wide range of loading conditions
  - Use discrete automatic setpoint adjustment in favor of nested PI loop setpoint resets whenever possible.
  - Avoid long/variable time-constant PI loop control when possible.
  - Establish standard PI loop parameters for each application that are responsive but stable over a wide range of loading conditions.

As additional buildings are completed, this document should be updated and appended to include additional system types and configurations encountered within the district, as well as updates to sequences resulting from lessons learned.

DEFINITIONS, ADDITIONAL FUNCTIONALITY, AND STARTING VALUES

This section contains definitions for terms used in the detailed sequence sections and the starting values for adjustable variables defined and/or used in the definitions shall apply to detailed sequence sections unless provided in the detailed sequence, where listed starting values differ the detailed sequence shall govern. Definitions and functionality in this section shall be used in sequence/tuning pages as if they were included in the detailed sequence section, where applicable. Sensor specifications listed in this section shall govern if more stringent that the specifications elsewhere in the project manual.

Alarm – Refers to remote notification of defined conditions. Refer to Section 230994 for Alarm Level Definitions and associated actions. Alarm Levels are provided with equipment-specific alarms within the Detailed Sequences. In addition, the following Alarms shall be defined and functional within the system:

- Issue a Critical Priority Alarm on Controller Communication Loss, if more than 1 (adj) controllers at any given school / facility are not communicating for 30 minutes (adj)
- Issue a Low Priority Alarm on 24/7 Operation, if any applicable equipment (applicable equipment includes all equipment that should not run for more than 24 hours) status = ON for more than 24 hours.

Calculated CHW Demand – is a calculated variable based on CHW valve position and design flow for the CHW coil being served, see equation below. This variable is used for chiller staging and therefore should include all CHW valves served by the chiller plant that it is applied to, regardless of unit status or exclusion from other calculations. For example, an AHU serving a mechanical room may be excluded from consideration related to Cool Requests but should always be included in the Calculated CHW Demand calculation as long as the chilled water system is running.

$$CALCULATED\ CHW\ DEMAND = \sum_{i=1}^{n} (CHW\ Design\ Flow_i * CHW\ Valve\ Position_i)$$

Cooling Available – For chilled water cooling, Cooling Available is True if at least one chilled water distribution pump is ON and the chilled water supply temperature falls below 65°F (adj) for 5 minutes (adj), False if chilled water supply temperature rises above 70°F (adj) for 10 minutes (adj).

Cool Request – A Cool Request shall be generated at the AHU level for the purpose of call for the central chiller plant to run. Cool Request is true of the AHU is Occupied (or other normal operating mode such as night setback or optimal start, etc.), in Cool Mode, and the CHW Valve opens to 10% (adj) or more. Cool Request is false if the CHW Valve closes and remains closed for more than 10 minutes (adj). Only one Cool Request is required to start the chilled water system, but certain AHU's may be excluded from consideration, such as units that are not scheduled to run via the Occupied Schedule, such as units that serve electrical and mechanical rooms.

Cooling Mode – Mode of operation where the unit is cooling.

Condensation Prevention – This condition is used in OAHU's and applicable AHUs with untreated OA intakes to reduce the possibility of introducing high dewpoint temperature air into the building and reduce the possibility of condensation on surfaces within the building envelope.

Controller Communication Loss Alarm – The system shall monitor communications with each controller in a facility and indicate when any controller is not communicating with other controllers. For any given facility, if more than 1 (adj) controllers are not communicating for 60 minutes (adj) then provide an Alarm on the Campus Summary graphic and the Main Floor Plan graphic for the affected facility.

Controlling Value – A process value specified in the sequence that is used to increment/decrement a control variable for process setpoint optimization. The value is to be defined to include more than one single process value and/or exclude selected process values for fault tolerance as follows:

Variable Set [x1,x2,…,xn], *excluding selected values (see Excluded Value)*

Avg.Value = Average of Variable Set

Max.Value = Maximum within the Variable Set

Controlling Value = (Avg.Value + (N * Max.Value)) / (N+1)

N = user definable weight to give to the Max.Value, starting point N = 3 (adj.) for most applications, unless otherwise noted in the specific application section.

Note: Is some cases, the Controlling Value is a function of the minimum value rather than the maximum value and would be calculated using the same method and equation above by replacing "Max.Value" with "Min.Value", where Min.Value = Minimum within the Variable Set.

Examples:

For static pressure setpoint, the Controlling Value is associated with the process value: Controlling Primary Air Damper Position and will increment/decrement below/above 80%/90% (adj/adj.)

For CHW coil supply air temperature setpoint, the Controlling Value is associated with the process value: (Controlling Space Temperature – CSP) and will increment/decrement above/below +0.5/-0.5 (adj./adj.)

Dehumidify Active – a subset of Cooling Mode that ensures the unit is producing a dewpoint low enough to dehumidify the supply air and maintain the zone dewpoint setpoint.

Demand Controlled Ventilation (DCV) – DCV is used to reduce outside air flow requirements as allowed by governing codes. Per ASHRAE 62.1 – 2022: "Where CO2 sensors are used for DCV, the CO2 sensors shall be certified by the manufacturer to be accurate within ±75 ppm at concentrations of both 600 and 1000 ppm when measured at sea level at 77°F (25°C). Sensors shall be factory calibrated and certified by the manufacturer to require calibration not more frequently than once every five years. Upon detection of sensor failure, the system shall provide a signal that resets the ventilation system to supply the required minimum quantity of outdoor air (Vbz) to the breathing zone for the design zone population (Pz)."

Excluded Value – Any value that is specifically excluded from the Controlling Value calculation. The system shall be programmed and configured so that the user, with appropriate rights granted, to select/deselect any value used in the calculation of any Controlling Value, from the GUI.

Failed Space T Sensor – In addition to manufacturer's normal failure detection, system shall "fail" a temperature sensor that reads greater than 120°F or less than 20°F. For all unit types a failed space temperature sensor shall cause unit to remain in Ventilate Mode when Enabled and not transition to Heating Mode or Cooling Mode. A failed sensor will not be used to initiate Unoccupied Heating/Cooling.

Freeze Prevention (Sequences only) – this condition is based on a software "switch" that initiates actions within each applicable system to reduce the possibility of freezing within the system. This is not to be confused with Freeze Stats or other "last resort" measures that require manual resets (See Freeze Protection). No manual resets shall be required for Freeze Prevention.

CHW System – For Air Cooled Chillers, Freeze Prevention is used to prevent the chiller evaporators and associated exposed piping from freezing. In addition, building distribution pumps are activated in response to OAHU and AHU Freeze Prevention sequences.

CW System – For Water Cooled Chillers, Freeze Prevention is used to prevent the water in Cooling Tower basins and CW piping from freezing.

HHW System – Freeze Prevention is an imbedded part of the sequence, based on Heat Request, used to prevent OAHU HHW Coils from freezing. In addition, building distribution pumps are activated in response to OAHU and AHU Freeze Prevention sequences.

OAHU – OAHU Freeze Prevention is used to prevent OAHU Preheat and OAHU Cooling Coils from freezing and prevent activation of manual reset freeze protection devices (See "Freeze Protection").

AHU – AHU Freeze Prevention is used to prevent Heating and Cooling Coils from freezing where appropriate and prevent activation of manual reset freeze protection devices (See "Freeze Protection").

Freeze Protection (Devices and Sequences) – Means provided to protect equipment from imminent freezing by hardwired locking switch requiring manual reset. This mechanism is generally referred to as a "Freeze Stat" or "Low Limit Switch" and is generally associated with OA intake equipment but may also be applied to other equipment. Activation of a Low Limit

Switch (Freeze Stat) anywhere in the system will generally result in activation of the heating hot water system as well as the chilled water pumps, depending on the equipment being protected. Freeze Protection is a last resort protective action, as opposed to the preventive action associated with "Freeze Prevention" mode and related sequences intended to prevent the activation of the protective device (Low Limit Switch or Freeze Stat) and associated manual reset of those devices. See also "General" section under "Group 2 – Fresh Air and Exhaust Systems".

General OA Schedule – This is a general schedule that defines the time of day when the fresh air equipment should be enabled. In general, the schedule is applied on a building-by-building basis and is intended to affect all the general OA and Exhaust equipment in that building. Enabling any individual fresh air device or system is not dependent solely on the General OA Schedule, rather the Detailed Sequences evaluate several parameters, including the status of the General OA Schedule, to determine if the fresh air equipment should be enabled or not. See also OA Shutdown Schedule. Note: OA Shutdown Schedule and General OA Schedule are mutually exclusive, in other words any given BAS will have one or the other but not both. In all instances where the Detailed Sequence references the General OA Schedule, the detailed sequence logic shall be reversed if the BAS uses OA Shutdown Schedule. Example: If the Detailed Sequence says, "General OA Schedule = ON", this shall be replaced with "OA Shutdown Schedule = OFF"

Heating Available – For hot water heating, Heating Available is True if at least one Hot Water distribution pump is ON and Heating Hot Water supply temperature is greater than 75°F (adj) for 5 minutes (adj), False if hot water supply temperature falls below 70°F (adj) for 5 minutes (adj).

Heat Request – A Heat Request shall be generated at the AHU and/or Terminal Unit level for the purpose of a call for the central heating plant to run.

Heating Mode – Mode of operation where the unit is actively heating for normal occupant comfort applications. This is not to be confused with Reheat Active (a subset of Cooling Mode) or Mixed Air Preheat Active (independent of AHU Mode).

Mixed-Air Temperature – Temperature of the mixed Outside Air and Return Air stream for any AHU type. In the field, there is seldom enough mixing of the two streams to accurately measure the Mixed-Air Temperature using a probe style sensor, therefore anytime Mixed Air Temperature measurement is specified a serpentine style sensor shall be provided.

Mixed-Air Preheat Active – Some AHU's are equipped with a Mixed-Air Preheat Coil that is used to temper the mixed air in cases where there is a potential for very cold air to enter the AHU. This as a dual purpose: 1. Protect downstream coils from potential freezing conditions; 2. Prevent comfort complaints due to the distribution of very cold air through the supply air distribution system. The Mixed-Air Preheat may be active during any AHU operating mode, Cooling Mode, Ventilation Mode, or Heating Mode.

OA Shutdown Schedule – This is a general schedule that defines the time of day when the fresh air equipment should be disabled. In general, the schedule is applied on a building-by-building basis and is intended to affect all the general OA and exhaust equipment in that building. Disabling any individual fresh air device or system is not dependent solely on the OA Shutdown Schedule, rather the Detailed Sequences evaluate several parameters, including the status of the OA Shutdown Schedule, to determine if the fresh air equipment should be enabled or not. See also General OA Schedule. Note: OA Shutdown Schedule and General OA Schedule are mutually exclusive, in other words any given BAS will have one or the other but not both. In all instances where the Detailed Sequence references the General OA Schedule, the detailed sequence logic should be reversed if the BAS uses OA Shutdown Schedule. Example: If the Detailed Sequence says, "General OA Schedule = ON", this shall be replaced with "OA Shutdown Schedule = OFF"

Occupant Enable Override – Occupant override is active if a means of overriding the occupancy schedule is provided to the occupant in the form of a momentary pushbutton located on the zone thermostat or other means of occupant override is provided.

Occupant Setpoint Override – Occupant setpoint override is active if a means of overriding the normal occupied space temperature setpoint is provided to the occupant in the form of a user-adjustable thermostat. The amount of the space temperature adjustment shall be limited to an adjustable value (defulat = +/- 3°F) that can be set in the associated units sequence page under "Mode Control". All Occupant Setpoint Adjustment values shall be set to "zero" at midnight every night.

Occupied – area served is designated as Occupied by occupancy schedule or other means of indicating occupancy.

Optimum Start – shall be programmed to optimally start HVAC zones to achieve target space temperature at the occupied time with all of the following features at a minimum **(All of the below items shall be together on applicable AHU Tech pages)**.

- User selectable to enable or disable by individual occupied schedule (Note: the default programmed value for this feature shall be disabled from initial programming through substantial completion and turnover to Katy ISD)
- Adjustable temperature dead band to limit the operation of this feature, by individual Occupied Schedule.
- Adjustable times to limit the operation of this feature, by individual occupied schedule.
- A "learning" technique with the user selectable option to enable, disable or limit this feature by individual occupied schedule.
- Manually adjustable rate of recovery, for both heating and cooling, by individual occupied schedule
- The following shall be included on the tech page for all applicable AHU's.

Optimum Start	16.5
Optimum Start = Enabled or Disabled (user adjustable)	16.5
Optimum Start Deadband (DB) = 3°F (adj)	16.5
Optimum Start Heating Temperature = HSP – DB	16.5
Optimum Start Cooling Temperature = CSP + DB	16.5
Optimum Start Duration Limit = 90 minutes (adj)	16.5
Optimum Start Time of Day Latest Start Limit = 09:00 AM (adj)	16.5
Optimum Start Time of Day Earliest Start Limit = 04:00 AM (adj)	16.5
Optimum Start Learning = Disabled (adj)	16.5
Optimum Start Heating Rate of Recovery (HRR)= 5°F/hr (adj)	16.5
Optimum Start Cooling Rate of Recovery (CRR) = 5°F/hr (adj)	16.5
Optimum Start Heating Temperature Difference (OSHTD) = HSP – Space T	16.5
Optimum Start Cooling Temperature Difference (OSCTD)= Space T – CSP	16.5
Optimum Start Heating Duration = Min (OSHTD / HRR , Optimum Start Duration Limit)	16.5
Optimum Start Cooling Duration = Min (OSCTD / CRR, Optimum Start Duration Limit)	16.5
Optimum Heat Start Time of Day = Max (Occupied Start Time of Day – Optimum Start Heating Duration , Optimum Start Time of Day Earliest Start Limit)	16.5
Optimum Cool Start Time of Day = Max (Occupied Start Time of Day – Optimum Start Cooling Duration , Optimum Start Time of Day Earliest Start Limit)	16.5
Controlling Space T = *see Controlling Value definition and insert equation here*	16.5
If Controlling Space T < Optimum Start Heating Temperature then Optimum Start Active = True when ALL of the following are True, Else False	16.5
Occupied Schedule = False	16.5
Optimum Start = Enabled	16.5
Current Time > Optimum Heat Start Time of Day	16.5
Optimum Heat Start Time of Day < Optimum Start Time of Day Latest Start Limit	16.5
If Controlling Space T > Optimum Start Cooling Temperature then Optimum Start Active = True when ALL of the following are True, Else False	16.5
Occupied Schedule = False	16.5

Optimum Start = Enabled	16.5
Current Time > Optimum Cool Start Time of Day	16.5
Optimum Cool Start Time of Day < Optimum Start Time of Day Latest Start Limit	16.5

Proportional-Integral Control Loops – PI loops are to be used wherever specified in the Detailed Sequences. The following variables shall be adjustable from the associated Sequence/Tech page or special "Tuning" page (this is required to be part of the GUI and shall not require use of any other software or interface) and shall include the following adjustable values. PI loop proportional and integral component definitions vary from system to system, therefore starting values for adjustable proportional gains and integral gains are not provided but shall be included in the sequence/tuning pages wherever applicable.

- Proportional constant – this refers to the adjustable proportional component (P gain) of the PI Loop.
- Integral constant – this refers to the adjustable integral component (I gain) of the PI Loop.
- Dead band – this refers to the adjustable dead band within which the loop output does not change. If the system does not have a dead band variable, then one may be created by setting the setpoint equal to the process variable input whenever the process variable input is within the desired dead band
- Bias – this refers to an adjustable value within the PI loop output equation that is added to the other components such that if the error (PV – SP) is zero the loop output would be equal to the Bias. Whether provided as adjustable in the sequence/tuning pages or not, and unless otherwise noted in the detailed sequence section, **the starting value should be zero (0.0)**. Examples of when the bias starting value would be something other than zero include:
    - The bias could be used to offset a proportional-only loop (Integral Gain = 0, Derivative Gain = 0) output so that the loop output is some value other than zero when the error is zero, essentially creating a linear reset of loop output relative to any desired error band.
- Any other values that are critical to tuning and/or configuring the PID loop to meet the needs of the application.

Reheat Active – This term refers to a subset of Cooling Mode that generally only occurs when the unit is dehumidifying (Dehumidify Active). For AHU's with a reheat coil, this coil may also be used during Heating Mode, but with a different purpose and operating sequence. See the Detailed Sequence for each AHU type.

Secondary Cooling (DX cooling acting as secondary cooling to a primary cooling source such as a CHW Coil) – In some instances an area served by a Single Zone AHU with CHW Cooling Coil serving as the primary cooling source also includes a DX Cooling Coil that serves as a secondary cooling source. In these instances, the secondary cooling source is to be used for cooling according to the applicable section in the Detailed Sequence of Section 1.1.1. The two cooling sources should never operate at the same time. The secondary cooling source is to be used only when the primary cooling source is not available and according to the supervisory control sequence below.

Secondary Heating (Electric Duct Heater acting as secondary heating to a primary heating source such as a HHW Coil) - In some instances an area served by a Single Zone AHU with HW Heating Coil serving as the primary heating source also includes an Electric Duct Heater that serves as a secondary heating source. In these instances, the secondary heating source is to be used for heating according to the applicable section in the Detailed Sequence of Section 1.1.1. The two heating sources should never operate at the same time. The secondary heating source is to be used only when the primary heating source is not available and according to the applicable section in the Detailed Sequence of Section 1.1.1.

Software Manual Override – Manual Overrides and Timed Overrides shall be provided for all system outputs on the equipment graphic page. If any Manual Override is active for more that 24 hours (adj), generate an alarm to ECE.

Site-Specific Drawings and Specifications – the drawings and/or specifications that are applicable to a specific site. This standard document is intended to provide specific guidance that is applicable to all encountered permutations of a given system for the purpose of maintaining standard operating procedures across a wide variety of systems and equipment, therefore it does

include instruction that is not applicable to every site. The contractor should consult the Site-Specific Drawings and Specifications to apply this standard appropriately.

Trim and Respond Logic – Trim and Respond Logic is to be used wherever specified in the Detailed Sequence(s) for adjusting setpoints, fan speed, pump speed, etc. Specified variables shall be adjustable from the associated Sequence/Tech page or special "Tuning" page (this is required to be part of the GUI and shall not require use of any other software or interface) and shall include the following adjustable values.

Zone Ventilation %Demand (ZV%D) – the sum of the Airflow Setpoints from all terminal boxes served by a SDVAV AHU at any given time divided by the AHU Design CFM, units %. This value is used in SDVAV AHU OA Damper and RA Damper control sequences for applications with no process variable control. It is used in the same way that Supply Fan VFD Fan Speed is used in SZU and MZU OA Damper and RA Damper control sequences with no process variable control. The Min and Max values for ZV%D are calculated values and called ZV%D Min and ZV%D Max, respectively. ZV%D Min = Sum of terminal box CFM SP Min values / AHU Supply Fan CFM Design. ZV%D Max = Sum of terminal box CFM SP Max values / AHU Supply Fan CFM Design.

Zone Ventilation %Demand Ventilation Minimum (ZV%D Ventilation Min) – an adjustable value between 0% and 100% that is determined during commissioning that corresponds with the minimum ZV%D required to achieve OA Design CFM.

Zone Ventilation %Demand Override (ZV%DO) – an calculated value between 0% and 100% that is generated at the AHU level, for SDVAV AHU's, and broadcast to the AHU's associated terminal box controllers to override the CFM Setpoint Minimum at the box level, where the resulting minimum at each box is the greater of CFM Setpoint Minimum and the product of the ZV%DO value and the CFM Setpoint Maximum for each box. The value is the output from a trim-and-respond algorithm seeks to maintain the ZV%D at or above ZV%D Ventilation Min. The Min and Max values for ZV%DO shall be adjustable and called ZV%DO Min and ZV%DO Max, respectively. The Min and Max values will be adjusted as needed during commissioning. Starting values are as follows: ZV%DO Min = 0%, ZV%DO Max = 50%.

Unoccupied Operation – unit serving an unoccupied area is called to start for any reason, such as morning warmup/cooldown, optimum start, summertime unoccupied operation, etc.

Ventilation Mode – Mode of operation that includes air circulation only, the unit is not actively heating and not actively cooling while in this mode of operation.

DEMAND RESPONSE AND LOAD SHEDDING

Load Shedding control shall include specified graphic pages with all related inputs and output necessary for automatic and forced control. Required points include metered kW and KVAR and real time load shed signal inputs as defined herein. System shall be able to respond to forced load shed or automatically to input signal with user-selectable load shedding measures defined herein.

Note: "Forced" load shed simply implies that the load shed is implemented immediately by the operator and will conclude when the timer expires or the "force" is removed. The program shall end all "Forced" load sheds district-wide each night at midnight to ensure that a forced load shed is not active anywhere upon startup the next day, unless the operator forces a load shed after midnight on the same day.
Graphical Element Definitions

District-Wide Load Shed – a graphic page that includes the following elements at a minimum (see example at the end of this section):

- Status of automatic ERS and CLM inputs from governing entity
- Link to Forced Load Shed Schedule for ERS, CLM and 4CP types
- User adjustable Automatic Load Shed Enable/Disable

- User adjustable timer for Timed Forced Load Shed
- Start button for ERS, CLM, and 4CP Timed Forced Load Shed, and associated Cancel buttons
- Display status of timer (time remaining) for Timed Forced Load Shed
- Display status of ERS, CLM, and 4CP Load Shed

Building Summary Page – Add status of the Load Shed and the Load Shed Level to the Building Summary Page.
Load Shedding main graphic – a graphic page that includes the following elements at a minimum (see example at the end of this section):

- Display whole-building electric demand kW and kVA in real time if available. *NOTE: If the points are not available at the time of implementation, include a place for these values but display values as "not available".*
- Status of the following binary inputs:
    - Emergency Response Services (ERS) Load Shed Request
    - Commercial Load Management (CLM) Load Shed Request
    - *NOTE: Provide these points for future use even if they are not yet available or desired by Katy ISD.*
- Adjacent to the inputs defined above, display the following virtual binary output points.
    - Link to the Load Shed Schedule – this is a link to the scheduling feature used to manually implement load shedding at multiple facilities.
    - Forced Load Shed – this point shall be turned ON or OFF via scheduling function so that the start time and end time can be set in the schedule and the associated schedule may be applied across multiple schools. This point will be used by the Energy Manager to manually initiate a Load Shed event for ERS, CLM, or 4CP demand response.
    - Automatic Load Shed – this is manually Enabled or Disabled, if it is Enabled then the system will automatically follow the ERS, CRM, or 4CP Load Shed Request. *NOTE: This feature is to be provided for future use, even if automatic signals from ERS, CLM, or 4CP are not yet available or desired by Katy ISD.*
    - Building Load Shed Enable/Disable – this is user adjusted by the Energy Manager to enable or disable the Load Shed Active output for the building.
    - Building Load Shed Level Select – this is a user adjustable integer value from 1 to 8 that corresponds with the Load Shed Level table that defines measures to be included in each level.
    - Building Load Shed Active/Inactive – this point is ON if either the Forced Load Shed is ON or Auto Load Shed output is ON and the Load Shed Enable/Disable point = Enabled.
    - Link to AHU Inclusion Table – this is a link to another graphic page where the user can select or deselect specific AHU's for inclusion in the load shed measures implemented when Load Shed is Active.
- Load Shed Level / Measure Selection Table – this table allows the user to select specific measures associated with each load shed level.

AHU Inclusion Table – a graphic page that includes a list of all building AHU's where the user can select or deselect any AHU for inclusion or exclusion, respectively, in the Load Shedding measures for that building. The table shall list the area(s) served by each AHU.
The system shall be programmed to implement the Load Shed Measures defined below. These measures are listed, generally, in order from least intrusive to most intrusive. Less intrusive measures will have less of an impact on occupant comfort than more intrusive measures. At the same time, more intrusive measures may have a generally more direct (quicker) impact on building electricity demand than the less intrusive measures.

A. **Outdoor Air Shutdown** – shut down all OAHU's and close all OA Dampers except those that are specifically excluded by design for each school. This would include all OA equipment normally controlled by the OA Schedule for the building, and specifically exclude any system not normally controlled by the OA Schedule such as kitchen exhaust and make-up air equipment, lab exhaust systems, any exhaust fan controlled by a manual timer switch, and any other equipment excluded.

B. **Setpoint Relaxation** – increase space cooling setpoint and decrease heating sepoint for all zones associated with included AHU's (see AHU Inclusion Table) by an adjustable amount (°F).
C. **Cooling Coil DAT SP Increase** – increase the minimum DAT SP for all Cooling Coils by an adjustable amount (°F).
D. **AHU Fan Speed Limit** – set maximum fan speed for all included AHU's (see AHU Inclusion Table) to an adjustable speed (%).
E. **Pump Speed Limit** – set maximum pump speed for all variable speed distribution pumps to an adjustable value (%).
F. **Chiller Demand Limit** – set the Chiller Setpoint to an adjustable value (%).
G. **Chiller Plant State Limit** – limit the highest chiller plant state to an adjustable value (integer).
H. **AHU Shutdown** – shut down all included AHU's (see AHU Inclusion Table).

The main landing graphic for each building shall indicate that Load Shed is Active while any applicable variable is being manipulated by the Load Shed program. This shall also be shown in the building summary table.

Example Load Shed graphics are shown on the next two pages.

District-wide Load Shed Graphic Page with Required Elements

ON CLM Load Shed Request Input (Applies to IDR Meters only)
OFF ERS Load Shed Request Input (Applies to SMT and IDR meters)
OFF 4CP Load Shed Request Input (Applies to IDR Meters only)
Disabled Automatic Load Shed Enable/Disable

Link to CLM (IDR Only) Load Shed Schedule
Link to ERS (SMT & IDR) Load Shed Schedule
Link to 4CP (IDR Only) Load Shed Schedule

01:00 User adjustable Forced Load Shed Timer HH:MM

CLM (IDR Only) Timed Forced Load Shed | Cancel CLM Load Shed
ERS (SMT & IDR) Timed Forced Load Shed | Cancel ERS Load Shed
Link to 4CP (IDR Only) Load Shed Schedule | Cancel 4CP Load Shed

0:46 Time (HH:MM) Remaining in Load Shed Event

Active CLM Load Shed (IDR Only)
Inactive ERS Load Shed (SMT & IDR)
Inactive 4CP Load Shed (IDR Only)

Notes (these notes should be shown on the graphic)

1 CLM Load Shed input status
2 ERS Load Shed input status
3 4CP Load Shed input status
4 Enabled or Disabled, by user - enables or disables system to follow the ERS, CLM, or 4CP Load Shed Request automatically
5 Link to CLM Load Shed Schedule
6 Link to ERS Load Shed Schedule
7 Link to 4CP Load Shed Schedule
8 User adjustable Forced Load Shed Timer in HH:MM
9 Clicking left-hand button intiates CLM Forced Load Shed for selected time
Clicking Cancel stops the forced request and resets timer
10 Clicking left-hand button initiates ERS Forced Load Shed for selected time
Clicking Cancel stops the forced request and resets timer
11 Clicking left-hand button initiates 4CP Forced Load Shed for selected time
Clicking Cancel stops the forced request and resets timer
12 Displays time remaining in the Forced Load Shed
13 Displays "Active" if 4CP/CLM Load Shed is Active (Automatic, Scheduled, or Forced)
14 Displays "Active" if ERS Load Shed is Active (Automatic, Scheduled, or Forced)
15 Note that Automatic is only intiated if "Automatic Load Shed" is Enabled and associated input is ON

Building Load Shed Graphic Page with Required Elements

Building Demand (kW)	500 kW
Building Demand (kVA)	550 kVA
CLM Load Shed Request (IDR Only)	OFF
ERS Load Shed Request (IDR & SMT)	ON
4CP Load Shed Request (IDR Only)	OFF

Link to District Load Shed Screen	
Bldg. Load Shed Enable/Disable:	Enabled
Bldg. Load Shed Level Select:	1
	IDR
Bldg. Load Shed Active/Inactive:	Active
Link to AHU Inclusion Table	

LOAD SHED LEVEL = 1		LEVEL							
MEASURE		1	2	3	4	5	6	7	8
A	Outdoor Air Shutdown	☑	☑	☑	☑	☑	☑	☑	☑
B	Setpoint Relaxation (0 - 12°F)	0	1	2	2	2	2	4	8
C	AHU Fan Speed Limit (100% - 40%)	100%	100%	80%	60%	60%	60%	40%	40%
D	Cooling Coil DAT SP Increase (0 - 12°F)	0	0	0	1	2	4	8	8
E	CHW & HHW Pump Speed Limit (100% - 40%)	100%	100%	100%	100%	80%	80%	40%	40%
F	Chiller Demand Limit (100% - 40%)	100%	100%	100%	100%	100%	80%	40%	40%
G	Chiller Plant State Limit (Max State # - 0)	2	2	2	2	2	1	1	0
H	Non-Instructional AHU Shutdown	☐	☐	☐	☐	☐	☐	☐	☑
I	Instructional AHU Shutdown	☐	☐	☐	☐	☐	☐	☐	☐

Notes:

1 This button links to the District Load Shed Screen
2 Enabled or Disabled, by user - use this point to enable or disable setting Load Shed Active
3 User adjustable integer from 1 to 8
4 User adjustable Meter Type (IDR or SMT)
5 If Bldg. Load Shed Enable/Disable = Enabled then do the following
    If Meter Type = IDR Then
        Load Shed Active = Active only if ANY of the following are True, else Inactive
            Manual Load Shed = ON, AND, Type = CLM/4CP, OR, ERS
            Auto Load Shed = Active, AND, (CLM Request = ON, OR, ERS Request = ON))
    If Meter Type = SMT Then
        Load Shed Active = Active only if ANY of the following are True, else Inactive
            Manual Load Shed = ON, AND, Type =ERS
            Auto Load Shed = Active, AND, (ERS Request = ON)
7 Check boxes are user-selectable, any combination of measures may be selected for any Level
8 For user-adustable %, 100% = no shedding; for user adjustable °F values, 0°F = no shedding
9 User selectable: IDR or SMT
10 Display status of "Bldg. Load Shed Active/Inactive" on the District Summary page for each building

SEQUENCE TESTING & TUNING PAIDGES

The GUI shall include Sequence Testing & Tuning Pages as described below.

1. Follow and include all applicable portions of the Detailed Sequence (and exclude inapplicable portions, just as would be done on the graphics). Where the Detailed Sequence references logic defined elsewhere in the document, such as DEFINITIONS AND STARTING VALUES, include the referenced logic and variables as if they were part of the Detailed Sequence. Keep order of original sequence. Use same headings and groupings used in the original sequence. Place the name of the sequence along with the Sequence # and Version # at the top of the page (or any applicable subsections). Example: "Outside Air Handler Sequence - Section 2.1.1 - Version 12.2"

2. Group Sequence and Current/Adjustable variables together, on separate pages with clear headings, within component groups that follow the Detailed Sequence component groupings in the standard sequence document. Example: Group Sequence verbiage and Current/Adjustable variables and any applicable Tuning and Testing parameters such as PID loop tuning variables and Controlling Value related variables for “CHW Valve Control” together on the same page with clear heading, “CHW Valve Control” so that the operator can quickly find and navigate to the correct portion of the sequence.

3. Consistency in variable naming across the graphics and sequence/tech pages. In general, the name used on the graphics and for Current/Adjustable value should match the name used in the Sequence verbiage and the variable names used on the Sequence.

4. List Sequence verbiage on the left-hand side and corresponding Current/Adjustable variables on the right-hand side. All values related to Testing and Tuning such as PID loop tuning and Controlling Value related variables should be placed at the bottom of the section under the following heading, “Testing & Tuning”.

5. On the Sequence side, show logical (binary) results, like "True" or "False" or "Enabled/Disabled", etc. where the logical result is not readily gleaned from the Adjustable and Current value indicators on the right-hand side, or if providing the logical result provides significant improvement and/or transparency to program operation. Note: This is not intended to cause needless extra programming or program variable creation.

6. On the Sequence side, show default or starting value for adjustable values with (adj) listed next to the variable, this is to have a reference point in the future in case system becomes unstable due to inappropriate or erroneous settings.

7. On the Current/Adjustable values side, avoid repeating variables, a Current or Adjustable value only needs to be listed once within each component grouping unless repeating the variable makes sense for clarity. Exceptions to this rule include repeated values associated with Testing and Tuning parameters at the bottom of the page where a process variable and output variable may be included again next to PID loop tuning parameters for context and convenience while tuning.

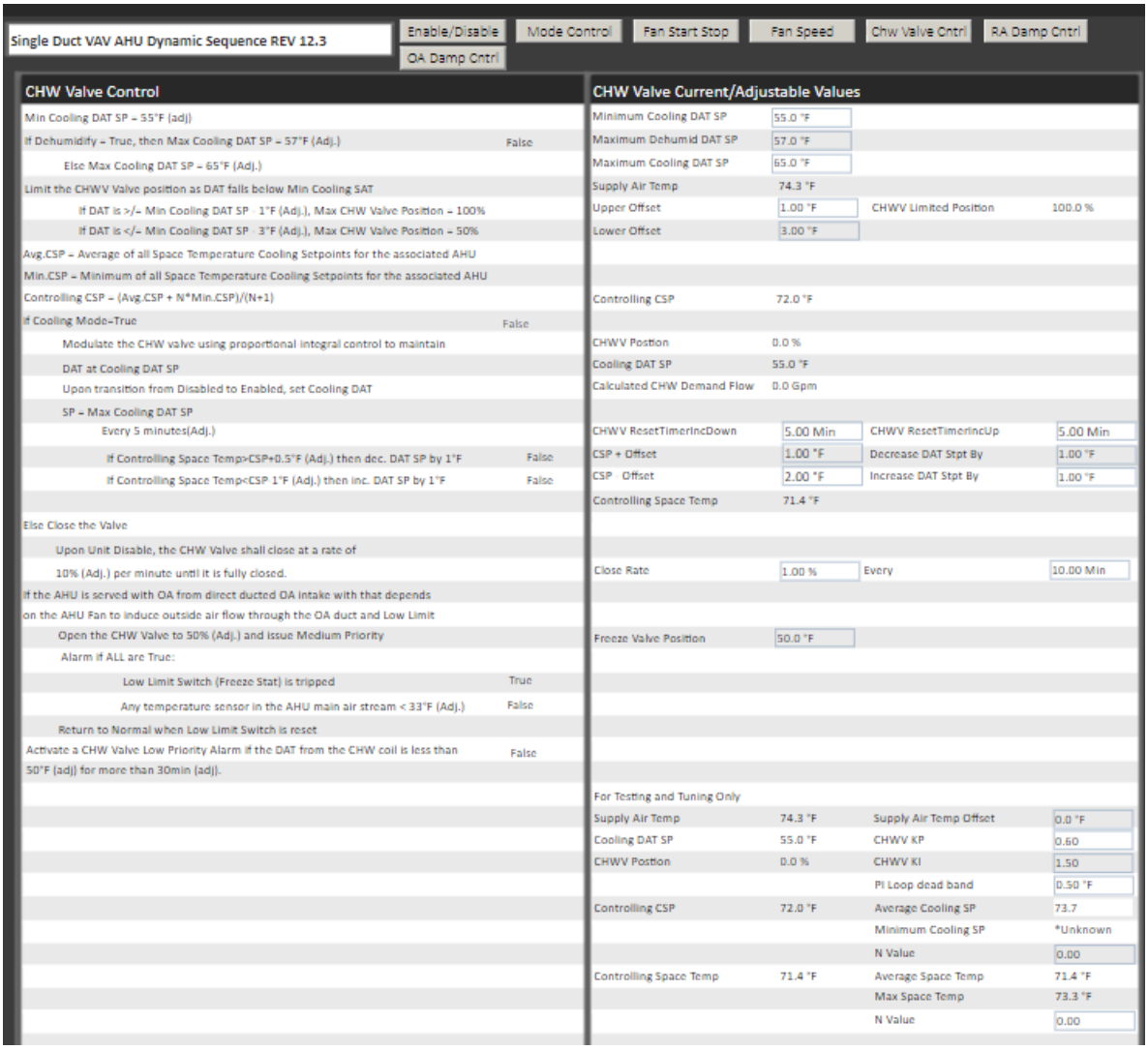
8. On the Current/Adjustable values side, differentiate between Current and Adjustable values by providing an indicator for Adjustable values that differentiates from Current values, the indicator must be uniform across all Sequence/Tech pages. Example, a box around Adjustable values, but not around Current values.

9. On the Current/Adjustable values side, locate the values adjacent to the corresponding Sequence verbiage. Wherever possible they should be listed on the very same line across from where the variable appears on the Sequence side.

10. On the Current/Adjustable values side, group related variables together. Example: Average, Max, N (adj) value, and resulting Controlling Value should be listed together. To avoid clutter on the page, these types of variables

that are not explicitly called on the Sequence side but are necessary for testing and tuning should be grouped underneath the Sequence and Current/Adjustable Variables at the bottom the page under a heading called, Testing and Tuning.

Example Screen Shots




Rev 12.5
General
Chiller Evaporator Isolation Valve Control
PCHWP Start/Stop
PCHWP Speed (Process Variable = Bldg CHW Differential Pressure)
PCHWP Minimum Speed = 33% (adj)
CHW Pump Min Speed 38.3 %
Min CHW DP SP = 5 psid (adj)
Min CHW DP SP 5.0 psid
Override Minimum CHW DP SP to 10 psid (adj) while Freeze Protection PCHWP Run Request = ON
Freeze Protection Run Request OFF
Freeze Min CHW DP SP 10.0 psid
Max CHW DP SP = 20 psid
Max CHW DP SP 15.0 psid
All running PCHWP's shall run at the same speed
On initial plant startup, set CHW DP SP = Min CHW DP SP
Avg. CHWV Position 0.8%
Max CHWV Position 18.0%
Control CHW Pump VFD Speed to maintain CHW DP at CHW DP SP using PI loop control
Weight (N) 2.0
Controlling CHWV Position = (Avg. CHWV Position + N * Max CHWV Position) / (N + 1)
Controlling CHWV Position 12.3 %
CHW DP SP 5.0 psid
Adjust CHW DP SP every 1 min (adj) between Min and Max as follows:
Dec SP Interval 00:06:00
Inc SP Interval 00:02:00
While Controlling CHW valve position < 40% (adj)
Min Controlling CHWV 40.0 %
Decrease CHW DP SP by 1 psid (adj)
Decrease Amount 0.3 psid

GROUP 1 – ZONED AIR CONDITIONING & HEATING SYSTEMS

GENERAL

Special Considerations & Definitions

Points and Diagrams – Diagrams and associated points in this section are for diagrammatic purposes. Site-specific points list(s) is(are) provided elsewhere in this specification.

Slow Closing Two-way CHW and HHW Valve Sequence – to avoid a sudden loss of flow at the central plant upon disabling many AHU's, the following measure shall be implemented for all two-way CHW and HHW valves in the system.

Child Zone Reheat Coil – Some zones that include areas that are susceptible to high infiltration or low U-value envelope such as vestibules and exterior rooms with large windows, as indicated in the design drawings, are equipped with a reheat coil that is served by a branch from an AHU or Terminal Unit. These units shall be interlocked in software to operate only when the associated unit is running and maintain temperature as measured by space temperature sensor located in the space served by the reheat coil by modulating the HHW control valve or electric heating stages, using proportional-integral control.

Child Zone Variable Volume Damper – In some instances a single room that is part of a larger zone served by a Single Zone AHU or MZU zone equipment or SDVAV zone equipment is equipped with a variable volume damper that is controlled by a space temperature sensor located in the room. Example, an office located adjacent a large instruction area that is served by the same equipment that serves the large instruction area. In this case, the sub-zone is treated like a child zone to the larger parent zone and shall be subject to the mode that is active for the parent zone. The temperature of the child zone shall be used with the temperature sensor of the parent zone to determine the Controlling Temperature for purposes of parent-zone mode determination. Subject to parent-zone mode, the child zone shall be controlled as follows:

- When Parent Zone is in Cool Mode, the Child Zone damper will maintain Cooling SP in the child zone using direct-acting PI loop control.
- When Parent Pone is in Vent Mode, the Child Zone damper shall remain fully open with no modulation.
- When Parent Zone is in Heat Mode, the Child Zone damper shall maintain Heating SP in the Child Zone using reverse-acting PI loop control.

Supplemental Cooling (Mini-split) - In some instances a single room that is part of a larger zone served by a Single Zone AHU or MZU zone equipment or SDVAV zone equipment is equipped with a stand-alone DX cooling unit that is controlled by a space temperature sensor located in the room. Example, a conference room located in an office suite that is served by the same equipment that serves the office suite. In this case, the child-zone setpoint is coordinated with the parent-zone setpoint as follows: The child zone Occupied/Unoccupied mode shall follow the parent zone, so no additional scheduling point is required. Setpoints for the child zone shall follow the same standards and limitations applied to the parent zone. The thermostat for the parent zone shall be in a room with adequate separation from the child zone thermostat location so that the two will not interact or conflict with one another. If proximity between the child zone thermostat and parent zone thermostat cannot be avoided, then the child zone setpoints shall be set to 1°F (adj) above the CSP for the parent zone in Occupied and Unoccupied states.

Supplemental Heat (Inline Fan with Electric Duct Heater) - In some instances a single room that is part of a larger zone served by a Single Zone AHU or MZU zone equipment or SDVAV zone equipment is equipped with a stand-alone inline fan (IF) and electric duct heater (EDH) that is controlled by a space temperature sensor located in the room. Example, an office located adjacent a large instruction area that is served by the same equipment that serves the large instruction area. In this case, the child-zone setpoint is coordinated with the parent-zone setpoint as follows: The child zone Occupied/Unoccupied mode shall follow the parent zone, so no additional scheduling point is required. Setpoints for the child zone shall follow the same standards and limitations applied to the parent zone. The thermostat for the parent zone

shall be in a room with adequate separation from the child zone thermostat location so that the two will not interact or conflict with one another. If proximity between the child zone thermostat and parent zone thermostat cannot be avoided, then the child zone setpoints shall be set to 1°F (adj) below the HSP for the parent zone in Occupied and Unoccupied states.

Fan Arrays – AHU's may be furnished with fan arrays (or fan wall) that incorporate multiple fans in parallel. These units shall be provided with backdraft damper on each individual fan and individual fan motor status and shall alarm individually per fan motor in instances where "Fan Failure" is defined in the detailed sequence of operation.

Zones Served By Multiple Units

It is common for a large zone to be served by more than one AHU, Terminal Box, etc. These applications can be divided into two (2) groups:

Group 1 – Zone served by multiple AHU's or terminal equipment that is controlled together based on a single Zone Temperature and Dewpoint Temperature (if equipped) measurement.

This group is typical of larger-than-normal classrooms, rooms with higher cooling load such as computer labs, or other room types where the room does not have a divider of any sort between areas served by each unit. In this case, one unit shall be called the "Leader" and all other unit(s) serving the same zone shall be called "Follower(s)". All Follower units shall follow the Leader's occupied & unoccupied cooling setpoint (CSP), occupied & unoccupied heating setpoint (HSP), and Mode (Cooling/Ventilation/Heating). Graphics shall clearly indicate each applicable unit as "Leader" and "Follower" and the unit's relationship to the other unit(s). For instance, if CVB-1 is "Leader" and CVB-2 is "Follower", then the graphic for CVB-1 shall be labeled "Leader of CVB-2" and the graphic for CVB-2 shall be labeled "Follower of CVB-1". CSP and HSP shall be adjustable from any of the unit graphic pages but the changes shall be applied to all applicable Leader and Follower units. Alternatively, the adjustable CSP and HSP shall only be displayed on the Leader's graphic page and each Follower's graphic page shall include a note directing the user to open the Leader's graphic page to adjust CSP and HSP.

Group 2 – Zone served by multiple SZ AHU's or terminal equipment that is controlled individually based on multiple zone Temperature and Dewpoint Temperature (if equipped) measurements that are individually associated with each AHU or Terminal Box.

This group is typical of very large zones such as gymnasiums, cafeterias, auditoriums, etc. or zones with moveable dividers such as LGI rooms. If the zone has moveable dividers then each unit shall control according to its own measured space temperature and dewpoint temperature (if equipped). If the zone does not have moveable dividers then the units shall be controlled in Group Mode based on a Controlling Space Temperature and Controlling Space Dewpoint temperature (if equipped).

A special case in this group includes very large zones that are fully occupied only during special events. Examples include the large event centers, competition gymnasiums, very large meeting rooms, etc. In these cases, an additional set of modes shall be programmed: Normal Mode and Event Mode. In Normal Mode, the equipment shall be staged to maintain the Controlling Space T. In Event Mode the equipment shall run simultaneously in Group Mode. Whenever more than one unit is running at once, each unit shall be controlled according to the Controlling Space T, Controlling RH, Controlling CO2, etc. Venues that are included in this special case group shall be equipped with a remote-mounted adjustable thermostat that can be used to adjust the CSP and HSP for all units.

Multiple Rooms Served By A Single Unit or Zone Equipment with Multiple Space Sensors

In cases where a single unit or zone from a multi-zone AHU serves multiple rooms, such as a single MZU zone serving multiple classrooms or offices, where space temperature, humidity, CO2, etc. is provided in more than one of the rooms

served, The system shall display all individual measurements as well as the calculated Controlling Value for each type of sensor where more than one of the sensor types exist. The respective Controlling Value shall be used in the sequence as if it were the measured process variable used for control according to the applicable Detailed Sequence.

Outside Air Damper & Return Air Damper System Types

GROUP 1 ZONED AIR CONDITIONING & HEATING systems (SZ AHU's, MZU's, SDVAV's) receive or draw fresh air into the air handler and distribute the fresh air (OA) mixed with return air (RA) to the occupied spaces. The OA intake and RA intake is frequently furnished with automatic dampers, either 2-position or modulating, that serve to regulate the amount of fresh air that is drawn into the air handler. Control sequences for these OA and RA Damper systems is provided in Section 2.1.2 of GROUP 2 – FRESH AIR AND EXHAUST SYSTEMS.

When VFD's are used to vary the supply fan speed on GROUP 1 air handlers, care must be taken to ensure that the air handler draws (or receives) the fresh air required when the supply fan is running at reduced speeds or in the case of SDVAV units, when the system air flow demand is below design. The detailed sequences contained herein include provisions for ensuring that the minimum amount of fresh air is provided to the occupied zones. This is provided under the Supply Fan Speed section of the detailed sequence for each system type: SZU, MZU, and SDVAV.

For SZU's and MZU's, where the ducting system does not change load (no modulating dampers within the air distribution system), a variable called "Ventilation Min Speed" is used to limit the minimum allowable fan speed during times when fresh air is required. For SDVAV's, where the ducting system does change with load (primary air dampers modulate to vary the amount of air introduced to each zone), a variable called "Zone Ventilation %Demand Override (ZV%DO)" is used to force the zone boxes to provide a minimum amount of airflow to each zone thereby forcing the air handler supply fan to run at a higher speed to maintain static pressure setpoint, during times when fresh air is required.

Regardless of the system type (SZU, MZU, or SDVAV), the method used to maintain the minimum fresh air requirement depends on the configuration and type of OA and RA Dampers (2-pos., modulating, none) and OA source (direct from outside or via OAHU) as well as whether the system uses a process variable such as CO_2 to maintain the required ventilation. The configurations encountered thus far include the following "Types". These "Types" are used within each detailed sequence to identify the correct sequence to apply in each case. Additional types may be added in future versions of this document to account for additional configurations encountered, if necessary.

TYPE	CONFIGURATION
1A	AHU with no OA Damper or 2-position OA Damper served by constant volume OA equipment or direct-ducted to the outside with NO PROCESS VARIABLE CONTROL
1B	AHU with no OA Damper or 2-position OA Damper served by constant volume OA equipment or direct-ducted to the outside WITH CO2 CONTROL
1C	AHU with no OA Damper or 2-position OA Damper served by dedicated variable volume OA fan WITH PROCESS VARIABLE CONTROL
2A	AHU with Modulating OA Damper with or without Modulating RA Damper (NO PROCESS VARIABLE CONTROL)
2B	AHU with Modulating OA Damper and NO RA Damper (WITH PROCESS VARIABLE CONTROL)

2C AHU with Modulating OA Damper AND Modulating RA Damper (WITH PROCESS VARIABLE CONTROL)

1.1 SINGLE ZONE SYSTEMS

General

This section applies to all single zone units (SZU), Roof Top Units (RTU) and fan coil units (FCU) with CHW or DX cooling and/or HHW or Electric heating.

The general diagrams in this section include points that may not be applicable to or needed for every SZU system. Likewise, the sequence of operation(s) includes instructions for components that may not be applicable to every system represented. However, the sequences are written so that elimination of components does not impact the operation of remaining components. Therefore, components that are not present may be treated as "Not Applicable".

Special Applications

Some single zone systems serve special applications other than comfort cooling and heating but will operate like standard SZU's with exceptions. These applications are generally intended to maintain temperatures within a specified range that is typically much larger than the range required for comfort cooling and heating. Furthermore, they will typically operate independent of building occupancy schedules and therefore are generally furnished with heating and/or cooling means that does not require operation of the central plant equipment. Some examples of spaces served by these special application SZU's are as follows.

- Mechanical/Electrical rooms
- IDF/MDF rooms
- Server rooms

These systems may include only heating or only cooling or neither heating nor cooling capabilities, such as those listed below.

- Fan Coil Unit (FCU) serving a mechanical room with chilled-water cooling coil but no heat.
- Fan Coil Unit (FCU) serving an MDF room with DX cooling but no heat.
- Transfer Fan (TF) serving and IDF room that is simply a fan activated by a thermostat to transfer air out of the zone and into the plenum or an adjacent zone but does not penetrate the conditioned portion of the building envelope.
- Unit Heater (UH) with hot water or electric heat but no cooling. Example, unit serving a shop area or mechanical room.
- Supply Fan (SF) or Exhaust Fan (EF) with no active heating or cooling means, that simply transfers outside air with air in the space to dissipate the heat added by electrical systems and/or motors, usually interlocked with a wall-mounted thermostat in a mechanical room or electrical room. Example, serving an unconditioned mechanical and/or electrical room.

In general, these types of units should follow the Detailed Sequence for a Standard Single Zone Unit (SZU) with exceptions as follows.

- If the unit provides heating and/or cooling for purposes other than human comfort, they will typically be enabled to operate regardless of building occupancy schedules, unless otherwise indicated in the job-specific Contract Documents. If it is unclear, the Contractor should submit a question for clarification in writing before proceeding.
- Components that are not applicable to the equipment should be considered as not applicable to the sequence of operation. Example: If an FCU with CHW coil serves a mechanical room and does not include heating

capability, then the Heat Mode of operation in the sequence does not apply and any sections describing the operation of heating components such as HHW Valve do not apply.

- In general, the supply fan for these types of units should cycle off when not in Heat Mode or Cool Mode, unless otherwise indicated in the job-specific Contract Documents.
- For chiller room and boiler room applications, the AHU or FCU providing cooling and heating shall be enabled whenever the chiller plant is running (as indicated by CHWP status) or the boiler plant is running (as indicated by HWP status), and follow the Occupied setpoints Cooling = 80°F, Heating = 45°F. Otherwise, the unit shall be OFF. The fan shall run in Cooling Mode and Heating Mode, and turn OFF in Ventilation Mode.

Redundant & Staged Systems

Applications where more than one single zone unit servers a single area and is called out in the design as Staged or Redundant, then the following shall apply and be included in the detailed sequence. This shall be displayed on a dedicated sequence page called “Staged SZU’s”

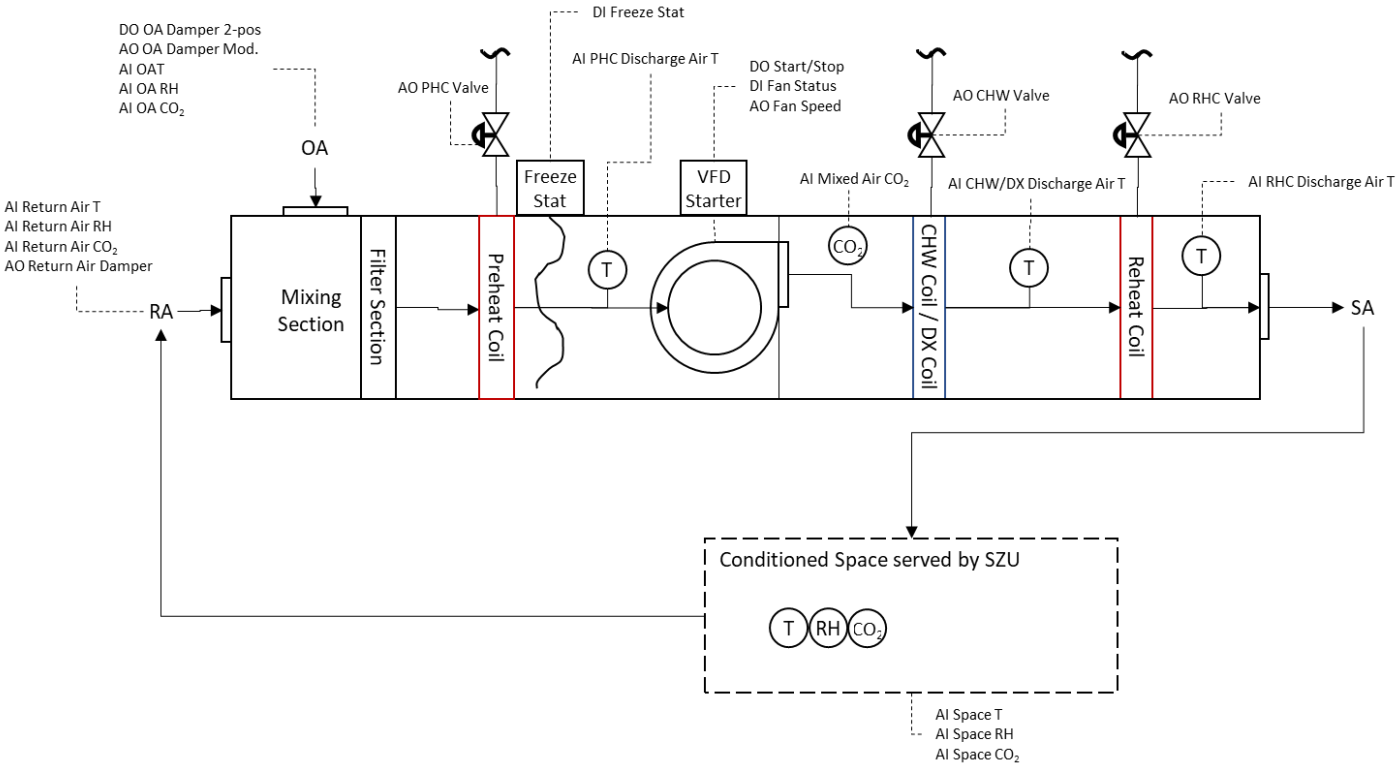
Operate the units as Lead/Lag with the adjustable CSP and HSP applying to the Lead unit as follows:

Lead unit
CSP = 74°F (adj)
HSP = 68°F (adj)
Min (CSP – HSP) Offset = 3°F (adj)

Lag unit
CSP = Lead Unit CSP + 2°F (adj)
HSP = Lead Unit HSP - 2°F (adj)

Swap Lead and Lag units on a weekly basis
Day of Week = Saturday (adj)
Time of Day = 2am (adj)

1.1.1 – SINGLE ZONE UNIT (SZU)



Detailed Sequence for SZU

Return Air Damper	Return Air Fan	Occupant	Preheat Coil	Cooling Coil	Reheat Coil	Default	SINGLE ZONE UNITS (Incl. all SZU types, Example: FCU, DX, RTU, etc.)	Revision History
						X	**General**	**0**
						X	*General Notes:* 1. *All OAT and OA dpT's referred to in this sequence are the global information from the central sensor(s) quality-control checked with weather station data, not the temperature sensor mounted at the OA inlet that is used for diagnostic purposes only.* 2. *For units provided with integrated controls for internal components, such as DX-AHU with Hot Gas Reheat, the BMCS shall provide supervisory control of the unit as necessary to follow this detailed sequence where applicable.*	0

							3. *This section provides definitions for variables that are used elsewhere in other sections and/or sequences.*	
			X				*For HW Pre-Heating*: see applicable parts [Preheat Coil] in Section 2.1.1 Detailed Sequence for OAHU under "General"	0
						X	*For Heat Recovery*: *see applicable parts [Heat Recovery] in Section 2.1.1 Detailed Sequence for OAHU under "General"*	0
						X	*If the AHU is served OA by direct ducted OA intake that depends on the AHU Supply Fan to induce outside air flow through the OA duct, then do the following:* AHU Freeze Prevention = True if ALL are True OA Temperature < 39F (adj) Any temperature sensor in the AHU main air stream < 39F (adj) Return to Normal when temperatures return to normal with a 2°F (adj.) Deadband	1.0
						X	*If Low Limit Switch (Freeze Stat) is installed anywhere in the main air stream, then do the following:* AHU Freeze Protection = True if Low Limit Switch (Freeze Stat) is tripped, manual reset required Return to Normal when Low Limit Switch is reset	1.0
						X	**Alarms**	**0.2**
						X	All of the following Alarms shall automatically clear upon return-to-normal	0.2
						X	Fan Fail to Start	0.2
						X	Fan in Hand	0.2
				X			CHW Valve Fail to Close	0.2
			X		X		HHW Valve Fail to Close	0.95
			X				Freeze Stat Trip	0.2
						X	**Optimum Start**	1.0
						X	*See Definitions Section of this document*	1.0
						X	**Enable/Disable**	0
						X	Enable the unit whenever ANY are true	0
						X	Occupied Schedule Active	0
						X	Optimum Start Active = True	0
						X	Unoccupied Cooling = True	0
						X	Unoccupied Heating = True	0
		X					Occupant Enable Override is Active	0
		X					Occupant Enable Override Time = 2 hours (adj)	0
		X					Occupant Enable Override Time Remaining = HH:MM	1.0
						X	*Note: Fan Status alone is not enough to Enable the unit and therefore should not enter Cooling Mode or Heating Mode or execute any other part of this detailed sequence based on Fan Status alone unless called for specifically in the detailed sequence. For example, if someone places a fan in Hand, this should not result in cooling or heating unless the unit is also Enabled according to this sequence, or as needed for safety interlocks and programming.7*	0
							Mode Control	0

				X			CSP = 74F (adj)	0
		X					Occupant Temperature Adjust Maximum = +/- 3°F (adj)	1.0
		X					Active Occupant Adjustment = XX °F	1.0
		X					Active Occupied Zone CSP = Occupied Zone CSP + Active Occupant Adjustment	1.0
					X		HSP = 68°F (adj)	0.9
		X					Active Occupied Zone HSP = Occupied Zone HSP + Active Occupant Adjustment	1.0
				X	X		Min (CSP – HSP) Offset = 3°F (adj)	0
				X			Unoccupied CSP = 95F (adj)	0
					X		Unoccupied HSP = 50F (adj)	0
				X			Unoccupied Cooling is True if Space T rises above the Unoccupied Cooling Setpoint + 2°F (adj), False if Space T is below Unoccupied Cooling Setpoint – 2°F (constant)	0
					X		Unoccupied Heating is True if Space T falls below the Unoccupied Heating Setpoint - 2F (adj), False if Space T is above Unoccupied Heating Setpoint + 2°F (constant)	0
				X			dpT SP = 57F (adj)	0
						X	Enter Ventilation Mode whenever unit is Disabled *Note: This statement is intended to ensure the unit shows "Ventilation Mode" while it is disabled and that the unit is in Ventilation Mode when it starts.*	0.9
				X			Enter Cooling Mode if ALL are True for 1 minute (adj)	0
				X			Unit is Enabled	0
				X			Ventilation Mode = True	0
				X			Space T > CSP – 0.5F (adj)	0
				X			If Cooling Mode = True	0
				X			*Note: Dehumidify is a subset of Cooling Mode and will never be ON unless the unit is in Cooling Mode and shall be displayed on the AHU graphic as "Dehumidify On" or "Dehumidify Off", according to the logic below, in addition to the active AHU Mode.*	0
				X			Dehumidify = ON if Space dpT > dpT SP + 1.0°F (adj)	0
				X			Dehumidify = OFF if Space dpT < dpT SP – 0.0°F (adj)	0
				X			If no Space dpT is present or if space dpT sensor is failed	0
				X			Dehumidify = ON if OA dpT > dpT SP + 1.0°F (adj)	0
				X			Dehumidify = OFF if OA dpT < dpT SP – 0.0°F (adj)	0
				X			If AHU has Economizer capability, then do the following:	0
				X			*Note: Economizer is a subset of Cooling Mode and will never be ON unless the unit is in Cooling Mode and shall be displayed on the AHU graphic as "Economizer On" or "Economizer Off", according to the logic below, in addition to the active AHU Mode.*	0
				X			If OAT dpT > 55°F then (Wet)	0
				X			Economizer = ON if OAT < 58°F (adj), Wet Econ. ON SP	0
				X			Economizer = OFF if OAT > Wet Econ. ON SP + 2°F (adj)	0
				X			If OAT dpT < 55°F then (Dry)	0

				X			Economizer = ON if OAT < 68°F (adj), Dry Econ. ON SP	0
				X			Economizer = OFF if OAT > Dry Econ. ON SP + 2°F (adj)	0
				X			Return to Ventilation Mode if ALL are True for 5 minutes (adj)	0
				X			Cooling Mode = True	0
				X			Dehumidify = OFF	0
				X			Space T < CSP - 1°F (adj)	0
					X		*Note: Reheat is a subset of Cooling Mode when Dehumidify = ON and will never be ON unless the unit is in Cooling Mode and Dehumidify is ON, and shall be displayed on the AHU graphic as "Reheat On" or "Reheat Off", according to the logic below, in addition to the active AHU Mode.*	0
					X		Reheat Auto/Off Option = "Auto" or "Off" (adj) *Note: Reheat Auto/Off applies only to the use of reheat for dehumidification comfort control. It should be set to "Off" for AHU's with VFD. Units without VFD should be evaluated during high latent load days to determine if reheat is needed for comfort control during dehumidification operation. For units with 100% OA, the Reheat Auto/Off Option should be set to "On".*	0
					X		If Reheat Auto/Off = "Auto", then do the following, else Reheat = OFF	0
					X		Reheat = OFF if ANY are True	0
					X		Dehumidify = OFF	0
					X		Space T > CSP – 1.5°F (adj)	0
					X		Reheat = ON if ALL are True	0
					X		Dehumidify = ON	0
					X		Space T < CSP – 2.0°F (adj)	0
				X			Return to Ventilation Mode if ALL are True for 5 minutes (adj)	0
				X			Cooling Mode = True	0
				X			Dehumidify = ON	0
				X			Space T < CSP - 2.5°F (adj)	0
					X		Enter Heating Mode if ALL are True for 1 minute (adj)	0
					X		Unit is Enabled	0
					X		Ventilation Mode = True	0
					X		Space T < HSP - 0°F (adj)	0
					X		If Heating Mode = True	0
					X		Return to Ventilation Mode if the Space T > HSP + 1°F (adj)	0
			X				*Note: the following logic is for the Preheat Coil, if one exists (the preheat coil referenced here is located in the AHU main air stream), and shall be displayed on the AHU graphic as "Preheat On" or "Preheat Off" according to the logic below, in addition to the active AHU Mode. Preheat may be On or Off regardless of what Mode the AHU is in, as determined above.*	0
			X				Preheat = On if ANY are True	0
			X				OAT < 45°F (adj), Preheat On SP	0
			X				Preheat Coil DAT < Preheat On SP	0
			X				Preheat = Off if ALL are True	0

			X				OAT > Preheat On SP + 5°F (adj)	0
			X				Preheat Coil DAT > Preheat On SP + 5°F	0
						X	**Associated Fresh Air and Exhaust Systems**	0
						X	*For control of associated Fresh Air and Exhaust systems that are interlocked with AHU operations, see Group 2 – Fresh Air and Exhaust Systems. Note: This includes all dedicated OA equipment whether separate "stand-alone" from the AHU or "piggy-back" style OA modules that are furnished as an integral part of the AHU (Section 2.1.1). This also includes separate and/or integral outside air dampers, return air dampers, and relief air dampers (Section 2.1.2).*	0
							Supply Fan Start/Stop	0
						X	Fan Auto/On Option = "Auto" or "On" (adj) *Note: The Fan Auto/On should only be set to "Auto" for units serving areas that are normally unoccupied such as mechanical rooms and common areas not used for instruction or assembly. The Fan Auto/On option should be set to "On" for units serving areas that are normally occupied such as classrooms, cafeterias, gymnasiums, auditoriums, etc.*	0
						X	If Unit is Enabled and Auto/On Option = Auto then do the following:	0
						X	Start the Fan whenever the unit enters Cool Mode or Heat Mode	0
						X	Stop the Fan whenever the unit enters Vent Mode for 1 minute (adj)	0.95
						X	If unit is Enabled and Auto/On Option = On then Start the Fan	0
						X	Stop the Fan if ANY Are True	1.0
						X	Unit is Disabled	1.0
						X	AHU Freeze Prevention = True (*if applicable*)	1.0
						X	AHU Freeze Protection = True (*if applicable*)	1.0
						X	*If the AHU is 100% OA then add the following conditions to stop the fan to the conditions above:*	1.0
						X	Stop the Fan if ANY are True	1.0
						X	OAHU Freeze Prevention = True (*Note: See Section 2.1.1 Detailed Sequence under "General" for OAHU Freeze Prevention Definition and include this definition in the "General" section of this Detailed Sequence*)	1.0
						X	OAHU Condensation Prevention = True (*Note: See Section 2.1.1 Detailed Sequence under "General" for OAHU Condensation Prevention Definition and include this definition in the "General" section of this Detailed Sequence*)	1.0
						X	OA Damper is Closed (this shall also be a hardwired interlock with Damper Closed end switch)	1.0
						X	*If the AHU is 100% OA then add the following conditions to stop the fan to the conditions above:*	1.0
						X	Stop the Fan if ANY are True	0
						X	OAHU Freeze Prevention = True (*Note: See Section 2.1.1 Detailed Sequence under "General" for OAHU Freeze Prevention Definition and include this definition in the "General" section of this Detailed Sequence*)	1.0

						X	OAHU Condensation Prevention = True (*Note: See Section 2.1.1 Detailed Sequence under "General" for OAHU Condensation Prevention Definition and include this definition in the "General" section of this Detailed Sequence*)	1.0
						X	OA Damper is Closed (this shall also be a hardwired interlock with Damper Closed end switch)	1.0
							Return Fan Start/Stop	0
	X						Start and Stop the AHU Return Air Fan in unison with the AHU Supply Air Fan	0
	X						If the Supply Air Fan Status = OFF, Stop the Return Air Fan	0
							Supply Fan Speed	0
						X	If Cooling Mode is True, Max Fan Speed = 100%	0
						X	If Cooling Mode is False, Max Fan Speed = the greatest of the following:	0
						X	Heating Max Speed = 80% (adj)	0
						X	Active Min Fan Speed as determined below	0
						X	Active Min Fan Speed is the greater of the following:	0
						X	Min Fan Speed = 50% (adj)	0
						X	Min Fan Speed Required For OA as determined below	0
						X	If General OA Schedule[1] = OFF then Min Fan Speed Required For OA = Min Fan Speed	0
						X	If General OA Schedule[2] = ON then Min Fan Speed Required For OA is determine as follows *(APPLY THE SEQUENCE CORRESPONDING WITH APPLICABLE OA SYSTEM TYPE BELOW, SEE GROUP 1 GENERAL SECTION FOR SYSTEM TYPE DESCRIPTIONS)*:	0
						X	*TYPE 1A - AHU with no OA Damper or 2-position OA Damper served by constant volume OA equipment or direct-ducted to the outside with NO PROCESS VARIABLE CONTROL*	0
						X	Min Fan Speed Required For OA = XX% (adj), *determined during start-up as follows:*	0
						X	*With 2-position OA Damper Open, increase the Fan Speed manually from 33% until minimum OA is achieved (as measured by a TAB contractor), set the Min Fan Speed Required For OA to the Fan Speed required to achieve minimum OA*.	0
						X	*TYPE 1B - AHU with no OA Damper or 2-position OA Damper served by constant volume OA equipment or direct-ducted to the outside WITH CO2 CONTROL*	0
						X	*Min Fan Speed Required For OA is determined as follows:*	0

[1] If "OA Shutdown Schedule" is used in lieu of "General OA Schedule" then the logic must be reversed as described in the Definitions section under "General OA Schedule" and "OA Shutdown Schedule".
[2] If "OA Shutdown Schedule" is used in lieu of "General OA Schedule" then the logic must be reversed as described in the Definitions section under "General OA Schedule" and "OA Shutdown Schedule".

						X	Adjust the Min Fan Speed Required For OA between Min Fan Speed and Max Fan Speed as follows, every 5 minutes (adj)	0
						X	While Controlling CO_2 > 1200 ppm (adj), increase the Min Fan Speed Required For OA by 7% (adj)	0
						X	While Controlling CO_2 < 800 ppm (adj), decrease the Min Fan Speed Required For OA by 5% (adj)	0
						X	*TYPE 1C - AHU with no OA Damper or 2-position OA Damper served by dedicated variable volume OA fan WITH PROCESS VARIABLE CONTROL*	0
						X	*Min Fan Speed Required For OA is determined as follows:*	0
						X	Adjust the Min Fan Speed Required For OA between Min Fan Speed and Max Fan Speed as follows, every 5 minutes (adj)	0
						X	If associated OA Fan Speed > 99% (adj), increase the Min Fan Speed Required For OA by 7% (adj)	0
						X	If associated OA Fan Speed < 90% (adj), decrease the Min Fan Speed Required For OA by 5% (adj)	0
						X	*TYPE 2A - AHU with Modulating OA Damper with or without Modulating RA Damper (NO PROCESS VARIABLE CONTROL)*	0
						X	Min Fan Speed Required For OA = XX% (adj)*, determined as follows:*	0
						X	*See Section 2.1.2 for method of determining the Min Fan Speed Required For OA setpoint.*	0
						X	*TYPE 2B - AHU with Modulating OA Damper and NO RA Damper (WITH PROCESS VARIABLE CONTROL)*	0
						X	*Min Fan Speed Required For OA is determined as follows:*	0
						X	Adjust the Min Fan Speed Required For OA between Min Fan Speed and Max Fan Speed as follows, every 5 minutes (adj)	0
						X	If OA Damper > 99% open (adj), increase the Min Fan Speed Required For OA by 7% (adj)	0
						X	If OA Damper < 90% open (adj), decrease the Min Fan Speed Required For OA by 5% (adj)	0
						X	*TYPE 2C - AHU with Modulating OA Damper AND Modulating RA Damper (WITH PROCESS VARIABLE CONTROL)*	0
						X	*Min Fan Speed Required For OA is determined as follows:*	0
						X	Adjust the Min Fan Speed Required For OA between Min Fan Speed and Max Fan Speed as follows, every 5 minutes (adj)	0

						X	If RA Damper = RA Damper Position Min (adj), increase the Min Fan Speed Required For OA by 7% (adj)	0
						X	If RA Damper > RA Damper Position Min + 10% (adj), decrease the Min Fan Speed Required For OA by 5% (adj)	0
						X	On transition from disabled to enabled, Supply Fan Speed = Active Min Supply Fan Speed	0
						X	In Cooling Mode, adjust the Fan Speed between Active Min Fan Speed and Max Fan Speed every 1 minutes (adj) as follows	0
						X	While the Space T >/= CSP + 1°F (adj) increase the Fan Speed by 7% (adj)	0
						X	While the Space T </= CSP – 0.0°F (adj) decrease the Fan Speed by 5% (adj)	0
						X	Limit the Fan Speed as Cooling Coil DAT rises above DAT SP	0
						X	Fan Speed Limit = Active Min Fan Speed when CC DAT = SP + 10F (adj)	0
						X	Fan Speed Limit = Max Fan Speed when CC DAT = SP + 5F (adj)	0
						X	Fan Speed Limit changes linearly between the limits above	0
						X	In Heating Mode, adjust the Fan Speed between Active Min Fan Speed and Max Fan Speed every 1 minutes (adj) as follows	0
						X	While the Space T </= HSP - 1°F (adj) increase the Fan Speed by 7% (adj)	0
						X	While the Space T >/= HSP + 0.0°F (adj) decrease the Fan Speed by 5% (adj)	0
						X	Limit the Fan Speed as Reheat Coil DAT falls below DAT SP	0
						X	Fan Speed Limit = Active Min Fan Speed when RHC DAT </= SP-10F (adj)	0
						X	Fan Speed Limit = Max Fan Speed when RHC DAT >/= SP-5F (adj)	0
						X	Fan Speed Limit changes linearly between the limits above	0
						X	In Ventilation Mode, Fan Speed = Active Min Fan Speed	0
							Return Fan Speed	0
	X						Min Return Air Fan Speed = 33% (adj)	0
	X						Max Return Air Fan Speed = 100% (adj)	0
	X						Return Air Fan Speed = Supply Air Fan Speed * 0.95 (adj)	0
							Preheat Valve	0
			X				*If Preheat Valve is used for space heating and no Reheat Valve or Electric Reheat is present, then follow Reheat Valve sequence in this section in addition to the Preheat Valve sequence provided below, use the highest resulting Preheat Coil DAT SP or valve position.*	0
			X				*Follow the Preheat Valve sequence provided in Section 2.1.1 – Detailed Sequence for OAHU under "Preheat Valve". Replace "Heating Mode =*	0

							True" with "Preheat = On", and replace "Heating Mode = False" with "Preheat = Off"	
							Preheat Electric Duct Heater	0
			X				*If Electric Preheat is used for space heating and no Reheat Valve or Electric Reheat is present, then follow Electric Reheat sequence in this section in addition to the Electric Reheat sequence provided in Section 2.1.1 and maintain highest resulting DAT SP (for SCR Control) or highest number of heating stages (for staged control).*	0
			X				*Follow the Preheat Valve sequence provided in Section 2.1.1 – Detailed Sequence for OAHU under "Electric Preheat". Replace "Heating Mode = True" with "Preheat = On", and replace "Heating Mode = False" with "Preheat = Off"*	0
							Cooling Coil CHW Valve	0
				X			If Cooling Coil CHW is the primary source of cooling in an AHU equipped with Secondary Cooling[3] then check Cooling Available[4] to determine which coil to use for cooling.	0
				X			If Cooling Available = True	0
				X			Enable Cooling Coil CHW Valve to operate according to the sequence below	0
				X			If Cooling Available = False	0
				X			Disable Cooling Coil CHW Valve control and close the valve, except for Freeze Prevention or Freeze Protection	0
				X			Min Cooling DAT SP = 55F (adj) *Note: set equal to or greater than the design DAT for the coil*	0
				X			If Dehumidify = True, then Max Cooling DAT SP = 57F (adj) *Note: this must be set equal to or less than the dpT SP for the space*	0
				X			Else Max Cooling DAT SP = 65F (adj.)	0
				X			Limit the CHWV Valve position as DAT falls below Design DAT (per Design Documents, adj)	0
				X			If DAT is >/= Design DAT - 1°F (adj), Max CHW Valve Position = 100%	0
				X			If DAT is </= Design DAT - 3°F (adj), Max CHW Valve Position = 50% (adj)	0
				X			If Cooling Mode = True	0
				X			Modulate the CHW valve using proportional-integral control to maintain DAT at Cooling DAT SP	0
				X			Upon transition from Disabled to Enabled, set Cooling DAT SP = Max Cooling DAT SP	0
				X			Adjust the DAT SP between Min and Max as follows	0
				X			Every 5 minutes (adj)	0
				X			If Space T > CSP+0°F (adj) then decrease Cooling DAT SP by 1F (adj)	0

[3] See DEFINITIONS AND STARTING VALUES for Secondary Cooling definition
[4] See DEFINITIONS AND STARTING VALUES for Cooling Available definition

				X			If Space T < CSP-1°F (adj) then increase Cooling DAT SP by 1F (adj)	0
				X			Else Close the Valve	0
				X			Upon Unit Disable, the CHW Valve shall close at a rate of 10% (adj) per minute until it is fully closed. Example: If the valve is 47% open when the unit goes from Enabled to Disabled, the valve will begin to close at rate of 4.7% per min until it is fully closed.	0
				X			*If applicable based on configurations as defined in the General section:* Open the CHW Valve to 50% (adj) and issue Medium Level Alarm if ANY are True: AHU Freeze Prevention = True AHU Freeze Protection = True	1.0
				X			*If Low Limit Switch (Freeze Stat) is installed anywhere in the main air stream, then do the following:* Open the CHW Valve 50% (adj)and issue Medium Level Alarm if Low Limit Switch (Freeze Stat) is tripped, manual reset required. Return to Normal when Low Limit Switch is reset	0
				X			Activate a CHW Valve Low Priority Alarm if the DAT from the CHW coil is less than 50°F (adj) for more than 30min (adj).	0
							Cooling Coil Staged DX	0
				X			*Note: This section applies to systems without packaged control, otherwise use packaged DX control means for compressor staging*	0
				X			If Cooling Coil Stage DX is the secondary source of cooling in an AHU equipped with Secondary Cooling[5] then check Cooling Available[6] to determine which coil to use for cooling.	0
				X			If Cooling Available = True	0
				X			Disable Cooling Coil Staged DX	0
				X			If Cooling Available = False	0
				X			Enable Cooling Coil Staged DX to operate according to the sequence below.	0
				X			If Dehumidify = True, Cooling Space Temperature Deadband = 1.5°F (adj)	0
				X			Else Cooling Space Temperature Deadband = 0.5°F (adj.)	0
				X			Min DX Stages = 0 (adj)	0
				X			Max DX Stage = 1 (adj, dependent on equipment)	0
				X			Min DX Stage ON Time = 10 minutes (adj)	0
				X			If Cooling Mode = True	0
				X			Adjust the DX Stages between Min and Max as follows	0
				X			Every 15 minutes (adj)	0
				X			If Space T > CSP+0.5°F (adj) then increase the DX Stage by 1 (adj)	0

[5] See DEFINITIONS AND STARTING VALUES for Secondary Cooling definition
[6] See DEFINITIONS AND STARTING VALUES for Cooling Available definition

				X			If Space T < CSP – Cooling Space Temperature Deadband then decrease the DX Stage by 1 (adj)	0
				X			Else DX Cooling = OFF	0
							Cooling Coil Staged DX w/ Hot Gas Reheat	0
				X			*Note: This section applies to systems without packaged control, otherwise used packaged DX control means for staging compressors and modulation of hot-gas reheat.*	0
				X			If Cooling Coil Stage DX w/ Hot Gas Reheat is the secondary source of cooling in an AHU equipped with Secondary Cooling[7] then check Cooling Available[8] to determine which coil to use for cooling.	0
				X			If Cooling Available = True	0
				X			Disable Cooling Coil Staged DX w/ Hot Gas Reheat	0
				X			If Cooling Available = False	0
				X			Enable Cooling Coil Staged DX w/ Hot Gas Reheat to operate according to the sequence below.	0
				X			If Dehumidify = True, Cooling Space Temperature Deadband = 1.5°F (adj)	0
				X			Else Cooling Space Temperature Deadband = 0.5°F (adj.)	0
				X			Min DX Stages = 0 (adj)	0
				X			Max DX Stage = 1 (adj, dependent on equipment)	0
				X			Min DX Stage ON Time = 10 minutes (adj)	0
				X			Min Cooling DAT SP = 55F (adj) *Note: may be adjusted at during according to space condition requirements, limited by system design*	0
				X			If Dehumidify = True, then Max Cooling DAT SP = 57F (adj) *Note: may be adjusted during tuning based on space condition requirements*	0
				X			Else Max Cooling DAT SP = 65F (adj.)	0
				X			If Cooling Mode = True	0
				X			Adjust the DX Stages between Min and Max as follows	0
				X			Every 5 minutes (adj)	0
				X			If Space T > CSP+0.5°F (adj) then increase the DX Stage by 1 (adj)	0
				X			If Space T < CSP – Cooling Space Temperature Deadband then decrease the DX Stage by 1 (adj)	0
				X			If Cooling Mode = True & Dehumidify = ON	0
				X			Modulate the Hot Gas Reheat using proportional-integral control to maintain DAT at Cooling DAT SP	0
				X			Upon transition from Disabled to Enabled, set Cooling DAT SP = Max Cooling DAT SP	0
				X			Adjust the DAT SP between Min and Max as follows	0
				X			Every 2 minutes (adj)	0
				X			If Space T > CSP+0°F (adj) then decrease Cooling DAT SP by 1F (adj)	0

[7] See DEFINITIONS AND STARTING VALUES for Secondary Cooling definition
[8] See DEFINITIONS AND STARTING VALUES for Cooling Available definition

				X			If Space T < CSP-1°F (adj) then increase Cooling DAT SP by 1F (adj)	0
				X			Else DX Cooling = OFF	0
					X		**Reheat Coil HHW Valve**	0
					X		If Reheat Coil HHW is the primary source of heat in an AHU equipped with Secondary Heating[9] then check Heating Available[10] to determine which coil to use for heating.	0
					X		If Heating Available = True	0
					X		Enable Reheat Coil HHW Valve to operate according to the sequence below	0
					X		If Heating Available = False	0
					X		Disable Reheat Coil HHW Valve control and close the valve, except for Freeze Prevention or Freeze Protection	0
					X		Heat Request = True if ANY of the following are True	0
					X		Heat Mode = True and Reheat Valve > 10% (adj) Open	0
					X		Cool Mode = True and ALL of the following are True	0.4
					X		Dehumidify = ON	0.4
					X		Reheat = ON	0.4
					X		Reheat Valve > 10% (adj) Open	0.4
					X		Freeze Prevention = True and Reheat Valve > 10% (adj) Open	0
					X		Freeze Protection = True	0
					X		Max Heating DAT SP = 95°F (adj)	0
					X		Min Heating DAT SP = 75°F (adj)	0
					X		Reheat DAT SP = 65°F (adj)	0.4
					X		If Heating Mode = True	0
					X		Modulate the HHW valve using PID control to maintain DAT at Heating DAT SP in Heating mode	0
					X		Upon transition from disabled to enabled, the Heating DAT SP = Min Heating DAT SP	0
					X		Adjust the Heating DAT SP between Min and Max as follows:	0
					X		Every 5 minutes (adj)	0
					X		If Space T > HSP + 0°F (adj) then decrease Heating DAT SP by 1F (adj)	0
					X		If Space T < HSP – 1°F (adj) then increase Heating DAT SP by 1F (ad)	0
					X		If ALL of the following are True then modulate the Reheat Valve to maintain AHU SAT = Reheat DAT SP using PI Control	0.4
					X		Cool Mode = True	0.4
					X		Dehumidify = ON	0.4
					X		Reheat = ON	0.4
					X		Upon Unit Disable, the HHW Valve shall close at a rate of 10% (adj) per minute until it is fully closed. Example: If the valve is 47% open when	0

[9] See DEFINITIONS AND STARTING VALUES for Secondary Heating definition
[10] See DEFINITIONS AND STARTING VALUES for Heating Available definition

							the unit goes from Enabled to Disabled, the valve will begin to close at rate of 4.7% per min until it is fully closed.	
					X		*If applicable based on configurations as defined in the General section:* Open the Reheat Valve to 50% (adj) and issue Medium Level Alarm if ANY are True: AHU Freeze Prevention = True (*if applicable*) AHU Freeze Protection = True (*if applicable*)	1.0
					X		**Reheat Coil Electric w/ SCR**	0
					X		If Reheat Coil Electric w/ SCR is the secondary source of heat in an AHU equipped with Secondary Heating[11] then check Heating Available[12] to determine which coil to use for heating.	0
					X		If Heating Available = True	0
					X		Disable Reheat Coil Electric w/ SCR	0
					X		If Heating Available = False	0
					X		Enable Reheat Coil Electric w/ SCR to operate according to the sequence below.	0
					X		Max Heating DAT SP = 95F (adj)	0
					X		Min Heating DAT SP = 75F (adj)	0
					X		Reheat DAT SP = 65°F (adj)	0.4
					X		If Heating Mode = True	0
					X		Modulate the SCR using PID control to maintain DAT at Heating DAT SP in Heating mode	0
					X		Upon transition from disabled to enabled, the Heating DAT SP = Min Heating DAT SP	0
					X		Adjust the Heating DAT SP between Min and Max as follows:	0
					X		Every 5 minutes (adj)	0
					X		If Space T > HSP + 0°F (adj) then decrease Heating DAT SP by 1F (adj)	0
					X		If Space T < HSP – 1°F (adj) then increase Heating DAT SP by 1F (ad)	0
					X		If ALL of the following are True then modulate the SCR to maintain AHU SAT = Reheat DAT SP using PI Control	0.4
					X		Cool Mode = True	0.4
					X		Dehumidify = ON	0.4
					X		Reheat = ON	0.4
					X		**Reheat Coil Staged Electric/Gas**	0
					X		If Reheat Coil Staged Electric/Gas is the secondary source of heat in an AHU equipped with Secondary Heating[13] then check Heating Available[14] to determine which coil to use for heating.	0
					X		If Heating Available = True	0
					X		Disable Reheat Coil Staged Electric/Gas	0
					X		If Heating Available = False	0

[11] See DEFINITIONS AND STARTING VALUES for Secondary Heating definition
[12] See DEFINITIONS AND STARTING VALUES for Heating Available definition
[13] See DEFINITIONS AND STARTING VALUES for Secondary Heating definition
[14] See DEFINITIONS AND STARTING VALUES for Heating Available definition

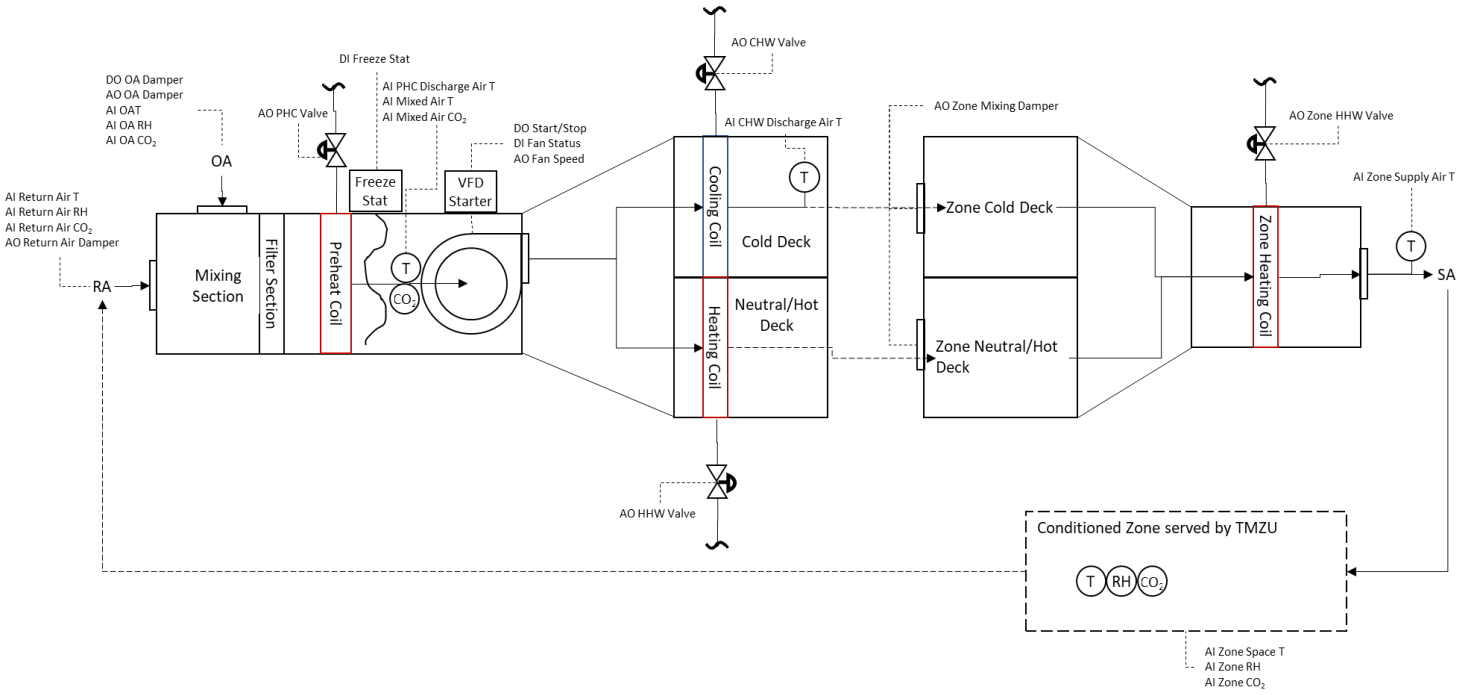
					X		Enable Reheat Coil Staged Electric/Gas to operate according to the sequence below.	0
					X		Max Heating Stages = 2 (adj, dependent on equipment)	0
					X		Min Heating Stages = 0 (adj)	0
					X		If Heating Mode = True	0
					X		Adjust the Heating Stages between Min and Max as follows:	0
					X		Every 5 minutes (adj)	0
					X		If Space T > HSP + 0°F (adj) then decrease Heating Stage by 1 (adj)	0
					X		If Space T < HSP – 1°F (adj) then increase Heating Stage by 1 (ad)	0
					X		If ALL of the following are True then turn on 1 (adj) stages of electric heat	0.4
					X		Cool Mode = True	0.4
					X		Dehumidify = ON	0.4
					X		Reheat = ON	0.4
							END OF DETAILED SEQUENCE	

1.2 – MULTIPLE ZONE WITH TERMINAL EQUIPMENT SYSTEMS

1.2.1 – MULTIZONE UNIT (MZU)

This section applies to all Multi-Zone AHU's with a Cold Deck and Neutral Deck with or without Neutral Deck Heating Coil (a.k.a. Hot Deck, although the term "Neutral Deck Heating Coil" is used in favor of "Hot Deck" in the Detailed Sequences below). Each zone has a Cooling Damper (a.k.a. Mixing Damper, although the term "Cooling Damper" is used in favor of "Mixing Damper" in the Detailed Sequences below) with or without Zone Heating Coil.

The following general diagram is for diagrammatic purposes only and includes components and points that may not be applicable to or needed for every MZU system. Likewise, the sequence of operation includes instructions for components that may not be applicable to every system. However, the sequences are written so that elimination of components does not impact the operation of remaining components, if the sequence is followed. Therefore, components that are not present may be treated as "Not Applicable".



Detailed Sequence for MZU

Return Air Damper	Return Air Fan	Relief Air Damper	OA Damper	Mixed Air Preheat Coil	Neutral Deck Heating	Default	MULTI-ZONE UNIT (MZU)	Revision History
						X	**General**	**1.0**

					X		Controlling Min Space T = (Avg. Space T + N * Min Space T)/(N+1) where:	1.0
					X		Avg. Space T = Average of all Space Temperatures for the associated AHU	1.0
					X		Min Space T = Min of all Space Temperatures for the associated AHU	1.0
					X		Controlling Max HSP = (Avg.CSP + N*Max.HSP)/(N+1) where:	1.0
					X		Avg.HSP = Average of all Space Temperature Heating Setpoints for the associated AHU	1.0
					X		Max.HSP = Max of all Space Temperature Heating Setpoints for the associated AHU	1.0
						X	*If the AHU is served OA by direct ducted OA intake that depends on the AHU Supply Fan to induce outside air flow through the OA duct, then do the following:* AHU Freeze Prevention = True if ALL are True OA Temperature < 39F (adj) Any temperature sensor in the AHU main air stream < 39F (adj) Return to Normal when temperatures return to normal with a 2°F (adj.) Deadband	1.0
						X	*If Low Limit Switch (Freeze Stat) is installed anywhere in the main air stream, then do the following:* AHU Freeze Protection = True if Low Limit Switch (Freeze Stat) is tripped, manual reset required Return to Normal when Low Limit Switch is reset	1.0
						X	**Optimum Start**	**1.0**
						X	*See Definitions Section of this document*	1.0
						X	**Enable/Disable**	**0**
						X	Unoccupied Zone Cooling Count = Count of zones with Unoccupied Zone Cooling Active	0
						X	Unoccupied Zone Heating Count = Count of zones with Unoccupied Zone Heating Active	0
						X	Enable the unit if ANY are True	0
						X	Occupied Schedule Active	0
						X	Optimum Start Active	0
						X	Unoccupied Zone Cooling Count > 0 (adj)	0
						X	Unoccupied Zone Heating Count > 0 (adj)	0
						X	Occupant Override is Active (*Note: this is controlled at the zone level, this shall be active if ANY Zone Occupant Override is Active*)	0
						X	*Note: Fan Status alone is not enough to Enable the unit and therefore should not enter Cooling Mode or Heating Mode or execute any other part of this detailed sequence based on Fan Status alone unless called for specifically in the detailed sequence. For example, if someone places a fan in Hand, this should not result in cooling or heating unless the unit is also Enabled according to this sequence.*	0
						X	**Alarms**	**0.2**

						X	All of the following Alarms shall automatically clear upon return-to-normal	0.2
						X	Fan Fail to Start	0.2
						X	Fan in Hand	0.2
						X	CHW Valve Fail To Close	0.2
				X			Preheat Valve Fail To Close	1.0
					X		Neutral/Hot Deck Heating Valve Fail To Close	1.0
						X	Freeze Stat Trip	0.2
						X	**Mode Control**	0
						X	dpT SP = 57F (adj.)	0
						X	Enter Ventilate Mode whenever unit is Disabled *Note: This statement is intended to ensure the unit shows "Ventilation Mode" while it is disabled and that the unit is in Ventilation Mode when it starts .*	0
						X	Enter Cooling Mode if ALL are True for 1 minute (adj)	0
						X	Unit is Enabled	0
						X	ANY associated Zone is in Cooling Mode	0
						X	If Cooling Mode is True	0
						X	Dehumidify = ON if Controlling Space dpT > dpT SP + 1F (adj)	0
						X	Dehumidify = OFF if Controlling Space dpT < dpT SP – 1F (adj)	0
						X	If Space dpT fails or does not exist	0
						X	Dehumidify = ON if OA dpT > OA dpT SP + 1F (adj)	0
						X	Dehumidify = OFF if OA dpT < OA dpT SP – 1F (adj)	0
						X	If AHU has Economizer capability, then do the following	0
						X	*Note: Economizer is a subset of Cooling Mode and will never be ON unless the unit is in Cooling Mode and shall be displayed on the AHU graphic as "Economizer On" or "Economizer Off", according to the logic below, in addition to the active AHU Mode.*	0.6
						X	If OAT dpT > 55°F (adj) then (Wet)	0.6
						X	Economizer = ON if OAT < 58°F (adj), Wet Econ. ON SP	0.6
						X	Economizer = OFF if OAT > Wet Econ. ON SP + 2°F (adj)	0.6
						X	If OAT dpT < 55°F (adj) then (Dry)	0.6
						X	Economizer = ON if OAT < 68°F (adj), Dry Econ. ON SP	0.6
						X	Economizer = OFF if OAT > Dry Econ. ON SP + 2°F (adj)	0.6
						X	**If Return Air T is available then Return Air T may be used in lieu of Controlling Space T. If so, then replace "Controlling Space T" with "Return Air T" on the Sequence Page.*	0
						X	Else Economizer = OFF and Dehumidify = OFF	0
						X	Return to Ventilate Mode if ANY are True for 5 minutes (adj)	0
						X	No associated Zone is in Cooling Mode	0
						X	Unit is Disabled	1.0
					X		Enter Heating Mode if ALL are True for 1 minute (adj)	1.0
					X		Unit is Enabled	1.0
					X		ANY associated Zone is in Heating Mode	1.0

					X		NO associated Zone is in Cooling Mode	1.0
					X		Controlling Min Space T < Controlling Max HSP - 3°F (adj)	1.0
					X		If Heating Mode = True	1.0
					X		Return to Ventilate Mode if ANY are True for 5 minutes (adj)	1.0
					X		Controlling Min Space T > Controlling Max HSP – 1°F (adj)	1.0
					X		Unit is Disabled	1.0
						X	**Associated Fresh Air and Exhaust Systems**	0
						X	*For control of associated Fresh Air and Exhaust systems that are interlocked with AHU operations, see Group 2 – Fresh Air and Exhaust Systems. Note: This includes all dedicated OA equipment whether separate "stand-alone" from the AHU or "piggy-back" style OA modules that are furnished as an integral part of the AHU (Section 2.1.1). This also includes separate and/or integral outside air dampers, return air dampers, and relief air dampers (Section 2.1.2).*	0
						X	**Supply Fan Start/Stop**	0
						X	Start the Supply Fan whenever the unit is Enabled	0
						X	Stop the Supply Fan if ANY are True	1.0
						X	Unit is Disabled	1.0
						X	AHU Freeze Prevention = True (*if applicable*)	1.0
						X	AHU Freeze Protection = True (*if applicable*)	1.0
	X						**Return Fan Start/Stop**	0
	X						Start and Stop the Return Air Fan in unison with the AHU Supply Air Fan	0
	X						If the Supply Air Fan Status = OFF, Stop the Return Air Fan	0
						X	**Supply Fan Speed**	0
						X	Max Supply Fan Speed = 100% (adj)	0
						X	Active Min Fan Speed = the greatest of the following:	0
						X	Min Fan Speed = 75% (adj)	0
						X	Min Fan Speed Required For OA, as determined below	0
						X	If General OA Schedule[15] = OFF then Min Fan Speed Required for OA = Min Fan Speed	0
						X	If General OA Schedule[16] = ON then Min Fan Speed Required for OA is determine as follows *(APPLY THE SEQUENCE CORRESPONDING WITH APPLICABLE OA SYSTEM TYPE BELOW, SEE GROUP 1 GENERAL SECTION FOR SYSTEM TYPE DESCRIPTIONS)*::	0
						X	*TYPE 1A - AHU with no OA Damper or 2-position OA Damper served by constant volume OA equipment or direct-ducted to the outside with NO PROCESS VARIABLE CONTROL*	0
						X	Min Fan Speed Required for OA = XX% (adj), *determined during start-up as follows:*	0

[15] If "OA Shutdown Schedule" is used in lieu of "General OA Schedule" then the logic must be reversed as described in the Definitions section under "General OA Schedule" and "OA Shutdown Schedule"
[16] If "OA Shutdown Schedule" is used in lieu of "General OA Schedule" then the logic must be reversed as described in the Definitions section under "General OA Schedule" and "OA Shutdown Schedule"

						X	*With 2-position OA Damper Open, increase the Fan Speed manually from 33% until minimum OA is achieved (as measured by TAB contractor), set the Min Fan Speed Required For OA to the Fan Speed required to achieve minimum OA.*	0
						X	*TYPE 1B - AHU with no OA Damper or 2-position OA Damper served by constant volume OA equipment or direct-ducted to the outside WITH CO2 CONTROL*	0
						X	*Min Fan Speed Required For OA is determined as follows:*	0
						X	Adjust the Min Fan Speed Required For OA between Min Fan Speed and Max Fan Speed as follows, every 5 minutes (adj)	0
						X	While Controlling CO_2 > 1200 ppm (adj), increase the Min Fan Speed Required For OA by 7% (adj)	0
						X	While Controlling CO_2 < 800 ppm (adj), decrease the Min Fan Speed Required For OA by 5% (adj)	0
						X	*TYPE 1C - AHU with no OA Damper or 2-position OA Damper served by dedicated variable volume OA fan WITH PROCESS VARIABLE CONTROL*	0
						X	*Min Fan Speed Required For OA is determined as follows:*	0
						X	Adjust the Min Fan Speed Required For OA between Min Fan Speed and Max Fan Speed as follows, every 5 minutes (adj)	0
						X	If associated OA Fan Speed > 99% (adj), increase the Min Fan Speed Required For OA by 7% (adj)	0
						X	If associated OA Fan Speed < 90% (adj), decrease the Min Fan Speed Required For OA by 5% (adj)	0
						X	*TYPE 2A - AHU with Modulating OA Damper with or without Modulating RA Damper (NO PROCESS VARIABLE CONTROL)*	0
						X	Min Fan Speed Required For OA = XX% (adj)*, determined as follows:*	0
						X	*See Section 2.1.2 for method of determining the Min Fan Speed Required For OA setpoint.*	0
						X	*TYPE 2B - AHU with Modulating OA Damper and NO RA Damper (WITH PROCESS VARIABLE CONTROL)*	0
						X	*Min Fan Speed Required For OA is determined as follows:*	0
						X	Adjust the Min Fan Speed Required For OA between Min Fan Speed and Max Fan Speed as follows, every 5 minutes (adj)	0

						X	If OA Damper > 99% open (adj), increase the Min Fan Speed Required For OA by 7% (adj)	0
						X	If OA Damper < 90% open (adj), decrease the Min Fan Speed Required For OA by 5% (adj)	0
						X	*TYPE 2C - AHU with Modulating OA Damper AND Modulating RA Damper (WITH PROCESS VARIABLE CONTROL)*	0
						X	*Min Fan Speed Required For OA is determined as follows:*	0
						X	Adjust the Min Fan Speed Required For OA between Min Fan Speed and Max Fan Speed as follows, every 5 minutes (adj)	0
						X	If RA Damper = RA Damper Position Min (adj), increase the Min Fan Speed Required For OA by 7% (adj)	0
						X	If RA Damper > RA Damper Position Min + 10% (adj), decrease the Min Fan Speed Required For OA by 5% (adj)	0
						X	On transition from disabled to enabled, Supply Fan Speed = Active Min Supply Fan Speed	0
						X	In Cooling Mode, adjust Supply Fan Speed between Active Min Fan Speed and Max Fan Speed as follows, every 1 minutes (adj)	0
						X	If Controlling Cold Deck Air Damper > 70% (adj) then increase Supply Fan Speed by 7% (adj)	0
						X	If Controlling Cold Deck Air Damper < 50% (adj) then decrease Supply Fan Speed by 5% (adj)	0
						X	In Ventilate Mode, set Supply Fan Speed at Active Min Supply Fan Speed	0
	X						**Return Fan Speed**	0
	X						Min Return Air Fan Speed = 33% (adj.)	0
	X						Max Return Air Fan Speed = 100% (adj)	0
	X						Return Air Fan Speed = Supply Air Fan Speed * Speed Offset Multiplier	0
	X						Speed Offset Multiplier = 0.95 (adj)	0
				X			**Mixed Air Preheat Coil HHW Valve**	0
				X			*Follow the Preheat Valve sequence provided in Section 2.1.1 – Detailed Sequence for OAHU under "Preheat Valve". Replace "Heating Mode = True" with "Preheat = On", and replace "Heating Mode = False" with "Preheat = Off"*	1.0
				X			*If applicable based on configurations as defined in the General section:* Open the Preheat Valve to 50% (adj) and issue Medium Level Alarm if ANY are True: AHU Freeze Prevention = True AHU Freeze Protection = True	1.0
				X			Activate a Preheat Coil Valve Fail To Close Low Priority Alarm if ANY are True DAT from the MA Preheat Coil > DAT SP + 3°F (adj) while Preheat = ON for more than 30min (adj)	1.0

							DAT from the MA Preheat Coil > Avg. Space T + 10°F (adj) while Supply Fan = ON and Preheat = OFF, all for more than 30min (adj)	
				X			**Mixed Air Preheat Coil Electric Duct Heater**	0
				X			*Follow the Preheat Valve sequence provided in Section 2.1.1 – Detailed Sequence for OAHU under "Electric Preheat". Replace "Heating Mode = True" with "Preheat = On", and replace "Heating Mode = False" with "Preheat = Off"*	0
						X	**CHW Valve**	0
						X	Min Cooling Coil DAT SP = 55F (adj)	0
						X	If Dehumidify = True, then Max Cooling DAT SP = 57F (adj)	0
						X	Else Max Cooling Coil DAT SP = 65F (adj)	0
						X	Limit the CHW Valve position as DAT falls below Design DAT (per Design Documents, adj.)	0
						X	If DAT is >/= Design DAT - 1°F (adj), Max CHW Valve Position = 100%	0
						X	If DAT is </= Design DAT - 3°F (adj), Max CHW Valve Position = 50% (adj)	0
						X	Controlling Max Space T = (Avg. Space T + N * Max Space T)/(N+1) where:	1.0
						X	Avg. Space T = Average of all Space Temperatures for the associated AHU	1.0
						X	Max Space T = Max of all Space Temperatures for the associated AHU	1.0
						X	Controlling Min CSP = (Avg.CSP + N*Min.CSP)/(N+1) where:	0
						X	Avg.CSP = Average of all Space Temperature Cooling Setpoints for the associated AHU	0
						X	Min.CSP = Minimum of all Space Temperature Cooling Setpoints for the associated AHU	0
						X	If Cooling Mode = True	0
						X	Modulate the CHW valve using proportional-integral control to maintain DAT at Cooling DAT SP	0
						X	Upon transition from disabled to enabled, the DAT SP = Max DAT SP	0
						X	Adjust the DAT SP between Min and Max as follows:	0
						X	Every 5 minutes (adj)	0
						X	If Controlling Space T > Controlling CSP + 0F (adj) then decrease DAT SP by 2F (adj)	0
						X	If Controlling Space T < Controlling CSP - 2F (adj) then increase DAT SP by 1F (adj)	0
						X	Else Close the Valve	0
						X	Upon Unit Disable, the CHW Valve shall close at a rate of 10% (adj) per minute until it is fully closed. Example: If the valve is 47% open when the unit goes from Enabled to Disabled, the valve will begin to close at rate of 4.7% per min until it is fully closed.	0
						X	*If applicable based on configurations as defined in the General section:*	1.0

							Open the CHW Valve to 50% (adj) and issue Medium Level Alarm if ANY are True: AHU Freeze Prevention = True AHU Freeze Protection = True	
						X	Activate a CHW Valve Fail To Close Low Priority Alarm if the DAT from the CHW coil is less than Design DAT - 3°F (adj) for more than 30min (adj).	0
					X		**Neutral Deck Heating Coil Valve**	**1.0**
					X		Min Neutral Deck Heating Coil DAT SP = 70F (adj)	1.0
					X		If Heating Mode = True, then Max Neutral Deck Heating Coil DAT SP = 95F (adj)	1.0
					X		Else Max Neutral Deck Heating Coil DAT SP = 80F (adj)	1.0
					X		*Note: Display Neutral Deck Heating "Active" or "Inactive" on the main AHU graphic according to the logic below. Neutral Deck Heating may be active even if Heating Mode = False*	1.0
					X		Neutral Deck Heating = Active If A OR B is True	1.0
					X		A: Heating Mode = True	1.0
					X		B: ALL of the following conditions are True	1.0
					X		ANY Zone Heating Mode = True	1.0
					X		Mixed Air Temperature < Controlling Max HSP + 1°F (adj)	1.0
					X		Neutral Deck Heating = Inactive If A AND B is True	1.0
					X		A: Heating Mode = False	1.0
					X		B: ANY of the following conditions are True	1.0
					X		ALL Zone Heating Mode = False	1.0
					X		Mixed Air Temperature > Controlling Max HSP + 2°F (adj)	1.0
					X		If Neutral Deck Heating = Active then	1.0
					X		Modulate the Neutral Deck Heating Coil valve using proportional-integral control to maintain DAT at Neutral Deck Heating Coil DAT SP	1.0
					X		Upon transition from Inactive to Active, the Neutral Deck Heating Coil DAT SP = Min Neutral Deck Heating Coil DAT SP	1.0
					X		Adjust the Neutral Deck Heating Coil DAT SP between Min and Max as follows:	1.0
					X		Every 5 minutes (adj)	1.0
					X		If Controlling Min Space T < Controlling Max HSP - 2F (adj) then Increase DAT SP by 1F (adj)	1.0
					X		If Controlling Min Space T > Controlling Max HSP - 1F (adj) then decrease DAT SP by 2F (adj)	1.0
					X		Else Close the Valve	1.0
					X		Upon Unit Disable, the Neutral Deck Heating Coil Valve shall close at a rate of 10% (adj) per minute until it is fully closed. Example: If the valve is 47% open when the unit goes from Enabled to	1.0

							Disabled, the valve will begin to close at rate of 4.7% per min until it is fully closed.	
					X		*If applicable based on configurations as defined in the General section:* Open the Neutral Deck Heating Coil Valve to 50% (adj) and issue Medium Level Alarm if ANY are True: AHU Freeze Prevention = True AHU Freeze Protection = True	1.0
					X		Activate a Neutral Deck Heating Valve Fail To Close Low Priority Alarm if ANY are True DAT from the Neutral Deck Heating Coil > DAT SP + 3°F (adj) while Neutral Deck Heating is Active for more than 30min (adj) DAT from the Neutral Deck Heating Coil > Avg. Space T + 10°F (adj) while Supply Fan = ON and Neutral Deck Heating is Inactive, all for more than 30min (adj)	1.0
							END OF DETAILED SEQUENCE	

Detailed Sequence for MZU Zone Control

Neutral Deck Heating Coil	Child Zone Reheat	Cooling Damper	Zone Heating Coil	Default	MULTI-ZONE UNIT (MZU) ZONE CONTROL	Revision History
				X	**General**	**0.1**
				X	Optimization Zone Excludes	0.1
				X	AHU Fan Speed Reset (Damper Position) = “Include” or “Exclude” (operator adjustable)	0.1
				X	CC DAT SP Reset (Zone T) = “Include” or “Exclude” (operator adjustable)	0.1
				X	**Enable/Disable**	0
				X	Enable the unit if ANY are True	0
				X	Occupied Schedule Active	0
				X	Optimum Start Active	0
				X	Unoccupied Zone Cooling is True	0
				X	Unoccupied Zone Heating is True	0
				X	Associated AHU is Enabled	0
				X	*If zone is equipped with Occupant Enable Override button then include the following:*	1.0
				X	Occupant Enable Override is Active if Occupied Override Time Remaining > 0, Else Occupant Enable Override is Inactive	1.0
				X	Occupant Enable Override Time (per push) = 2 minutes (adj)	1.0
				X	Override Time Remaining = HH:MM	13.5

				X	**TMZU Zone Mode Control**	0
				X	Zone CSP = 74F (adj.)	0
				X	Zone HSP = 68F (adj.)	0
				X	Min (CSP – HSP) Offset = 3F (adj)	0
				X	*If zone is equipped with Occupant Adjustable Zone Temperature Setpoint then include the following:*	1.0
				X	Occupant Zone Temperature Setpoint Adjust Range = +/- 3°F (adj)	1.0
				X	Active Occupant Adjustment = XX °F	1.0
				X	Active Occupied Zone CSP = Occupied Zone CSP + Active Occupant Adjustment	1.0
				X	Active Occupied Zone HSP = Occupied Zone HSP + Active Occupant Adjustment	1.0
				X	Unoccupied Zone CSP = 95F (adj.)	0
				X	Unoccupied Zone HSP = 50F (adj.)	0
				X	Unoccupied Zone Cooling is True if Space T rises above the Unoccupied Cooling Setpoint + 2F (adj), False if Space T is below Unoccupied Cooling Setpoint	0
				X	Unoccupied Zone Heating is True if Space T falls below the Unoccupied Heating Setpoint - 2F (adj), False if Space T is above Unoccupied Heating Setpoint	0
				X	Enter Ventilate Mode whenever unit is Disabled	0
				X	Enter Cooling Mode if ALL are True for 1 minutes (adj)	0
				X	Unit is Enabled	0
				X	Ventilate Mode = True	0
				X	Space T > Zone CSP – 1.5°F (adj)	0
				X	If Cooling Mode = True	0
				X	Return to Ventilate Mode if ALL are True for 15 minutes (adj)	0
				X	AHU Dehumidify = OFF	0
				X	Space T < Zone CSP – 2°F (adj)	0
				X	Return to Ventilate Mode if ALL are True for 15 minutes (adj)	0
				X	AHU Dehumidify = ON	0
				X	Space T < Zone CSP – 2.5°F (adj)	0
				X	Enter Heating Mode if ALL are True for 1 minutes (adj)	0
				X	Unit is Enabled	0
				X	Ventilate Mode = True	0
				X	Space T < Zone HSP – 1°F (adj)	0
				X	If Heating Mode = True	0
				X	Return to Ventilate Mode if the Space T > Zone HSP + 1°F (adj) for 5 minutes (adj)	0
		X			**Zone Cooling Damper Control (*with reverse-acting Neutral/Heating Damper*)**	0.0
		X			*Note: Zone Cooling Damper is connected to the Neutral Deck damper such that the Neutral Deck damper is reverse acting to the Zone Cooling Damper.*	1.0
		X			If Ventilate Mode is True	0
No		X			Zone Cooling Damper = 0% Open	0
Yes		X			Zone Cooling Damper Min position = 0% (adj)	1.0

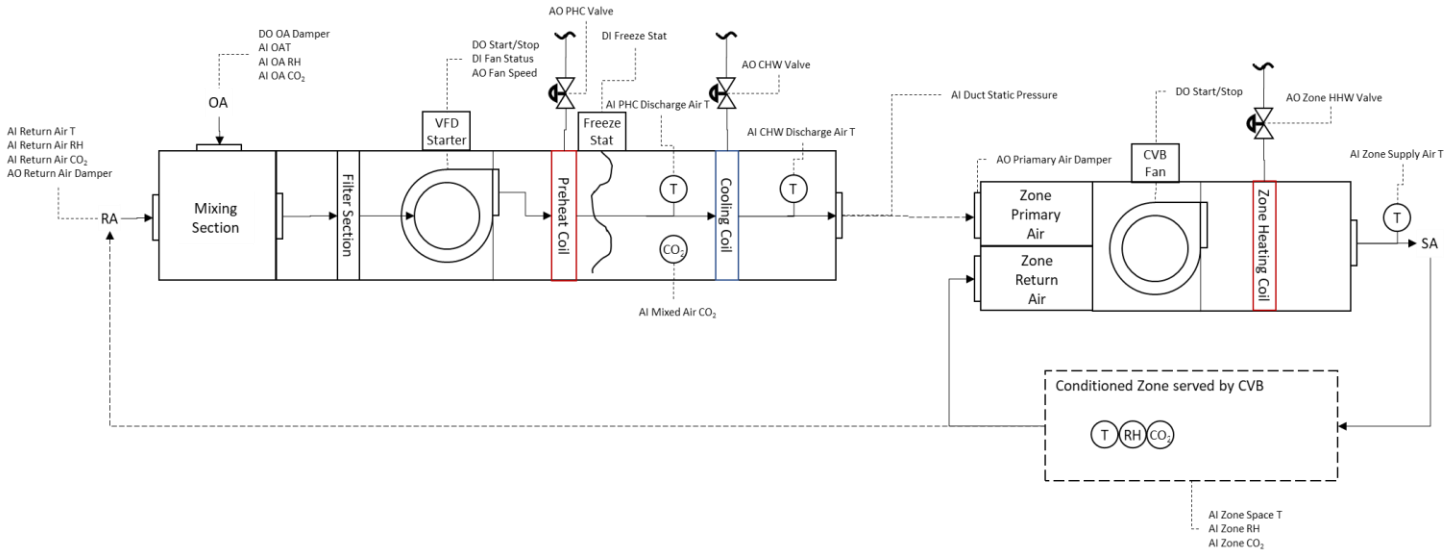
Yes		X			If AHU Neutral Deck Heating Coil = Active	1.0
Yes		X			Zone Ventilation SAT SP = Average of Zone HSP and Zone CSP	1.0
Yes		*X*			*If Zone Supply Air Temperature IS present then do the following:*	*1.0*
Yes		X			Modulate Zone Cooling Damper using proportional-integral control to maintain Zone Ventilation SAT SP	1.0
Yes		*X*			*If Zone Supply Air Temperature IS NOT present then do the following:*	*1.0*
Yes		X			Zone Cooling Damper = A / B, where:	1.0
Yes		X			A = AHU Neutral Deck Heating Coil DAT – Zone Ventilation SAT SP	1.0
Yes		X			B = AHU Neutral Deck Heating Coil DAT - AHU Cooling Coil DAT	1.0
		X			If Cooling Mode is True	0
		X			*If Zone Supply Air Temperature IS present then do the following:*	*1.0*
		X			Min Zone Cooling SAT SP = AHU Cooling DAT SP	0
		X			Max Zone Cooling SAT SP = 65°F (adj)	0
		X			Modulate Zone Cooling Damper using proportional-integral control to maintain Zone Cooling SAT SP	0
		X			Adjust Zone Cooling SAT SP between Min and Max using proportional-integral control to maintain Space T at CSP	0
		X			*If Zone Supply Air Temperature IS NOT present then do the following:*	*1.0*
		X			If AHU Dehumidify = ON then Min Zone Cooling Damper Position = 50% (adj)	1.0
		X			If AHU Dehumidify = OFF then Min Zone Cooling Damper Position = 0%	1.0
					Max Zone Cooling Damper Position = 100%	1.0
		X			Modulate Zone Cooling Damper between Min and Max using proportional-integral control to maintain Space Temperature at CSP	1.0
		X			If Heating Mode is True	0
No		X	Yes		*If Zone Reheat Coil is present and associated AHU does not have a Neutral Deck Heating Coil then do the following*	1.0
No		X	Yes		Mixing Damper = 0% open	1.0
Yes		X	No		*If associated AHU has a Neutral Deck Heating Coil and Zone Reheat Coil is not present then do the following*	1.0
Yes		X	No		*If Zone Supply Air T Sensor IS present then do the following*	1.0
Yes		X	No		Min Zone Heating SAT SP = 75F (adj.)	1.0
Yes		X	No		Max Zone Heating SAT SP = 95F (adj.)	1.0
Yes		X	No		Modulate the Mixing Damper to maintain Zone Supply Air T at Heating SAT SP using proportional-integral control	1.0
Yes		X	No		Adjust Zone Heating SAT SP between Min and Max, using proportional-integral control to maintain Space T at HSP	1.0

Yes		X	No		*If Zone Supply Air T Sensor IS NOT present then do the following*	1.0
Yes		X	No		Modulate the Mixing Damper to maintain Space T at HSP using proportional-integral control	1.0
			X		**Zone HHW Valve [Electric Heat]**	0
			X		Min Zone Heating SAT SP = 75F (adj.)	0
			X		Max Zone Heating SAT SP = 95F (adj.)	0
			X		If Heating Mode is True	0
			X		Modulate the HHW valve to maintain SAT at Heating SAT SP using proportional-integral control	0
			[X]		[Modulate SCR or control heating stages to maintain SAT at Heating SAT SP using proportional-integral control or ON/OFF control with manufacturer-recommended delays for staging on/off control]	0
			X		Adjust Zone Heating SAT SP between Min and Max, using proportional-integral control to maintain Space T at HSP	0
			X [X]		Else close the valve [Heat OFF]	0
	X				**"Child Zone" HHW Valve [Electric Heat]**	0
	X				If AHU Cooling Mode = False and AHU Fan Status = ON	0
	X				Modulate the Reheat Valve using proportional-integral control to maintain Space T at HSP	0
			[X]		[Modulate SCR or control heating stages using proportional-integral control to maintain Space T at HSP using proportional-integral control or ON/OFF control with manufacturer-recommended delays for staging on/off control]	0
					END OF DETAILED SEQUENCE	

1.2.2 – SINGLE-DUCT VARIABLE AIR VOLUME (SD-VAV)

This section applies to all Single-Duct VAV AHU's with CHW primary-air cooling coil and HHW zone reheat located downstream of each zone terminal unit. The terminal unit sequence applies to all CVB terminal units with series or parallel fan.

The following general diagram is for diagrammatic purposes only and includes points that may not be applicable to or needed for every system. Likewise, the sequence of operation includes instructions for components that may not be applicable to every system. However, the sequences are written so that elimination of components does not impact the operation of remaining components. Therefore, components that are not present may be treated as "Not Applicable".



Detailed Sequence for SD VAV

Return Air Damper	Return Air Fan	Relief Air Damper	OA Damper	Mixed Air Preheat Coil	Default	SINGLE-DUCT VARIABLE AIR VOLUME UNIT (SD VAV)	Revision History
					X	**Enable/Disable**	0
					X	Unoccupied Zone Cooling Count = Count of zones with Unoccupied Zone Cooling Active	0
					X	Unoccupied Zone Heating Count = Count of zones with Unoccupied Zone Heating Active	0
					X	Enable the unit if ANY are True	0
					X	Occupied Schedule Active	0
					X	Optimum Start Active	0
					X	Unoccupied Zone Cooling Count > 0 (adj)	0
					X	Unoccupied Zone Heating Count > 0 (adj)	0
					X	Manual Override is Active	0
					X	Manual Override Time = 2 hours (adj) *Note: this is adjustable at the zone level*	0
					X	*Note: Fan Status alone is not enough to Enable the unit and therefore should not enter Cooling Mode or Heating Mode or execute any other part of this detailed sequence based on Fan Status alone unless called for specifically in the detailed sequence. For example, if someone places a fan in Hand, this should not result in cooling or heating unless the unit is also Enabled according to this sequence.*	0
						Note: If unit comes on due to Optimum Start or Unoccupied Zone Cooling or Heating, then Occupy all associated zones until conditions	0

						calling for unit to run no longer exist (example, if Unoccupied Cooling Count goes below the required number to activate Unoccupied Cooling)	
					X	**Alarms**	**0.2**
					X	All of the following Alarms shall automatically clear upon return-to-normal	0.2
					X	Fan Fail to Start	0.2
					X	Fan in Hand	0.2
					X	CHW Valve Failure	0.2
				X		Freeze Stat Trip	0.2
					X	***Optimum Start***	0
					X	*Optimum Start = Disabled (adj)*	0
					X	*Optimum Start Deadband (DB) = 3°F (adj)*	0
					X	*Optimum Start Heating Temperature = Controlling HSP – DB*	0
					X	*Optimum Start Cooling Temperature = Controlling CSP + DB*	0
					X	*Optimum Start Time Limit = 90 minutes (adj)*	0
					X	*Optimum Start Learning = Disabled (adj)*	0
					X	*Optimum Start Heating Rate of Recovery (HRR)= 10 minutes/°F (adj)*	0
					X	*Optimum Start Cooling Rate of Recovery (CRR) = 10 minutes/°F (adj)*	0
					X	*Optimum Start Heating Temperature Difference (HTD) = HSP – Controlling Low Space T*	0
					X	*Controlling Low Space T = (Avg. Space T + N * Min. Space T) / (N+1)*	0
					X	*Optimum Start Cooling Temperature Difference (CTD)= Controlling High Space T – CSP*	0
					X	*Controlling High Space T = (Avg. Space T + N * Max. Space T) / (N+1)*	0
					X	*Optimum Start Heat Up Time = Minimum (HRR * HTD, Optimum Start Time Limit)*	0
					X	*Optimum Start Cool Down Time = Minimum (CRR * CTD, Optimum Start Time Limit)*	0
					X	*Optimum Heating Start Time = Occupied Start Time – Optimum Start Heat Up Time*	0
					X	*Optimum Cooling Start Time = Occupied Start Time – Optimum Start Cool Down Time*	0
					X	*If Space T < Optimum Start Heating Temperature, then Optimum Start Active = True when ALL of the following are True*	0
					X	*Occupied Schedule = False*	0
					X	*Optimum Start = Enabled*	0
					X	*Current Time = Optimum Heating Start Time*	0
					X	*If Space T > Optimum Start Cooling Temperature, then Optimum Start Active = True when ALL of the following are True*	0
					X	*Occupied Schedule = False*	0
					X	*Optimum Start = Enabled*	0
					X	*Current Time = Optimum Cooling Start Time*	0
					X	**Mode Control**	0
					X	dpT SP = 57F (adj)	0

					X	Enter Ventilate Mode whenever unit is Disabled	0
					X	Enter Cooling Mode if ALL are True for 1 minute (adj)	0
					X	Unit is Enabled	0
					X	Ventilate Mode = True	0
					X	ANY associated CVB is in Cooling Mode	0
					X	If Cooling Mode is True	0
					X	Dehumidify = ON if Controlling Space dpT > dpT SP + 2°F (adj)	0
					X	Dehumidify = OFF if Controlling Space dpT < dpT SP – 2°F (adj)	0
					X	If Space dpT does not exist	0
					X	Dehumidify = ON if OA dpT > OA dpT SP + 2°F (adj)	0
					X	Dehumidify = OFF if OA dpT < OA dpT SP – 2°F (adj)	0
					X	If AHU has Economizer capability, then do the following	0
					X	*Note: Economizer is a subset of Cooling Mode and will never be ON unless the unit is in Cooling Mode and shall be displayed on the AHU graphic as "Economizer On" or "Economizer Off", according to the logic below, in addition to the active AHU Mode.*	0.6
					X	If OAT dpT > 55°F (adj) then (Wet)	0.6
					X	Economizer = ON if OAT < 58°F (adj), Wet Econ. ON SP	0.6
					X	Economizer = OFF if OAT > Wet Econ. ON SP + 2°F (adj)	0.6
					X	If OAT dpT < 55°F (adj) then (Dry)	0.6
					X	Economizer = ON if OAT < 68°F (adj), Dry Econ. ON SP	0.6
					X	Economizer = OFF if OAT > Dry Econ. ON SP + 2°F (adj)	0.6
					X	**If Return Air T is available then RAT may be used in lieu of Controlling Space T. If so, replace "Controlling Space T" with "Return Air" T on Sequence Page.*	0
					X	Else Dehumidify = OFF, Economizer = OFF	0
					X	Return to Ventilate Mode if ALL are True for 5 minutes (adj)	0
					X	No associated zone is in Cooling Mode	0
					X	**Associated Fresh Air and Exhaust Systems**	0
					X	*For control of associated Fresh Air and Exhaust systems that are interlocked with AHU operations, see Group 2 – Fresh Air and Exhaust Systems. Note: This includes all dedicated OA equipment whether separate "stand-alone" from the AHU or "piggy-back" style OA modules that are furnished as an integral part of the AHU (Section 2.1.1). This also includes separate and/or integral outside air dampers, return air dampers, and relief air dampers (Section 2.1.2)*	0
					X	**Fan Start/Stop**	0
					X	Start the Fan whenever ALL are True	0
					X	AHU is Enabled	0
					X	All associated fan-powered box fans have been started	0
					X	Stop the Fan whenever the unit is Disabled	0
					X	*If the AHU is served OA by direct ducted OA intake that depends on the AHU Supply Fan to induce outside air flow through the OA duct and OA Low Limit Switch (Freeze Stat) is present, then do the following:* Stop the AHU Fan and issue Medium Priority Alarm if ANY are True:	0

						OAT < 39F (adj) Any temperature sensor in the AHU main air stream < 39F (adj) Return to Normal when temperatures return to normal with a 2°F (adj.) Deadband	
					X	*If Low Limit Switch (Freeze Stat) is installed anywhere in the main air stream, then do the following:* Stop the Supply Fan and issue Medium Priority Alarm if Low Limit Switch (Freeze Stat) is tripped, manual reset required. Return to Normal when Low Limit Switch is reset	0
	X					Start and Stop the Return Air Fan in unison with the AHU Supply Air Fan	0
	X					If the Supply Air Fan Status = OFF, Stop the Return Air Fan	0
					X	**Fan Speed**	0
					X	Min Supply Fan Speed = 50% (adj.)	0
					X	Max Supply Fan Speed = 100% (adj)	0
					X	Duct Static Pressure Setpoint Min = 0.5 inwc (adj)	0
					X	Duct Static Pressure Setpoint Max = 1.5 inwc (adj)	0
					X	Modulate Fan Speed to maintain Duct Static Pressure at SP	0
					X	Upon transition from disabled to enabled, the Duct Static Pressure SP = Min Static Pressure SP	0
					X	Adjust the Duct Static Pressure SP between Min and Max as follows:	0
					X	Every 5 minutes (adj)	0
					X	If Controlling Primary Air Damper > 90% (adj) then increase Static Pressure SP by 0.1 (adj)	0
					X	If Controlling Primary Air Damper < 80% (adj) then decrease Static Pressure SP by 0.1 (adj)	0
	X					Min Return Air Fan Speed = 50% (adj)	0
	X					Max Return Air Fan Speed = 100% (adj)	0
	X					Return Air Fan Speed = Supply Air Fan Speed * Speed Offset Multiplier	0
	X					Speed Offset Multiplier = 0.95 (adj)	0
					X	AHU Design CFM = Design CFM for the AHU according to Design Documents (adj)	0
					X	Zone Ventilation %Demand (ZV%D) = Sum of terminal box Primary Air Flow SP values / AHU Design CFM	0
					X	ZV%D Min = Sum of terminal box Design Min CFM values / AHU Design CFM	0
					X	ZV%D Max = Sum of terminal box Design Max CFM value / AHU Design CFM	0
					X	ZV%D Ventilation Min = XX% (adj) *where the value determined during start-up using method described in section 2.1.2 that represents the ZV%D required to achieve OA Design CFM when no process variable control is present. If process variable control for ventilation is present then ZV%D Ventilation Min = 0% (adj).* *Note: The ZV%D Ventilation Min can be set to zero when process variable control is present because Zone Ventilation %Demand*	0

						Override (ZV%DO) defined below is used to adjust the amount of ventilation dynamically based on the process variable reading, such as CO2.	
					X	*NOTE: THE SEQUENCE BELOW IS USED TO INCREASE THE AIR FLOW TROUGHPUT OF THE SYSTEMS WHEN NECESSARY TO MAINTAIN REQUIRED VENTILATION RATES DURING PERIODS OF LOW COOLING LOAD TO KEEP THE TOTAL TERMINAL BOX DEMAND AT OR ABOVE THE OVERALL OA RATE REQUIRED.*	0
					X	Zone Ventilation %Demand Override (ZV%DO) = a value between ZV%DO Min and ZV%DO Max that is broadcast to each terminal box and used to calculate the Ventilation Min CFM for each Zone, respectively, using the following equation: Ventilation Min CFM = ZV%DO * Design Max CFM, as described in the Detailed Sequence for SDVAV Zone Control.	0
					X	ZV%DO Min = 0% (adj)	0
					X	ZV%DO Max = 100% (adj)	0
					X	If General OA Schedule[17] = OFF, then ZV%DO = ZV%DO Min	0
					X	If General OA Schedule[18] = ON, then ZV%DO is determined as follows *(APPLY THE SEQUENCE CORRESPONDING WITH APPLICABLE OA SYSTEM TYPE BELOW, SEE GROUP 1 GENERAL SECTION FOR SYSTEM TYPE DESCRIPTIONS)*:	0
					X	*TYPE 1A*	0
					X	Adjust ZV%DO between Min and Max as follows, every 5 minutes (adj)	0
					X	While ZV%D < ZV%D Ventilation Min – 10% (adj), Increase ZV%DO by 7% (adj)	0
					X	While ZV%D > ZV%D Ventilation Min + 0% (adj), Decrease ZV%DO by 5% (adj)	0
					X	***Note: ZV%D Ventilation Min** is determined by testing described in Section 2.1.2.*	0
					X	*TYPE 1B*	0
					X	Adjust ZV%DO between Min and Max as follows, every 5 minutes (adj)	0
					X	While Controlling CO_2 > 1200 ppm (adj), increase the ZV%DO by 7% (adj)	0
					X	While Controlling CO_2 < 800 ppm (adj), decrease the ZV%DO by 5% (adj)	0
					X	*TYPE 1C*	0
					X	Adjust the ZV%DO between Min and Max as follows, every 5 minutes (adj)	0

[17] If "OA Shutdown Schedule" is used in lieu of "General OA Schedule" then the logic must be reversed as described in the Definitions section under "General OA Schedule" and "OA Shutdown Schedule"
[18] If "OA Shutdown Schedule" is used in lieu of "General OA Schedule" then the logic must be reversed as described in the Definitions section under "General OA Schedule" and "OA Shutdown Schedule"

					X	If associated OA Fan Speed > 99% (adj), increase the Zone Ventilation %Demand Override by 7% (adj)	0
					X	If associated OA Fan Speed < 90% (adj), decrease the Zone Ventilation %Demand Override by 5% (adj)	0
					X	*TYPE 2A*	0
					X	Adjust ZV%DO between Min and Max as follows, every 5 minutes (adj)	0
					X	While ZV%D < ZV%D Ventilation Min – 10% (adj), Increase ZV%DO by 7% (adj)	0
					X	While ZV%D > ZV%D Ventilation Min + 0% (adj), Decrease ZV%DO by 5% (adj)	0
					X	***Note: ZV%D Ventilation Min** is determined by testing described in Section 2.1.2.*	0
					X	*TYPE 2B*	0
					X	Adjust the ZV%DO between Min and Max as follows, every 5 minutes (adj)	0
					X	If OA Damper > 99% open (adj), increase the Zone Ventilation %Demand Override 7% (adj)	0
					X	If OA Damper < 90% open (adj), decrease the Zone Ventilation %Demand Override by 5% (adj)	0
					X	*TYPE 2C*	0
					X	Adjust the ZV%DO between Min and Max as follows, every 5 minutes (adj)	0
					X	If RA Damper Position = RA Damper Position Min, increase the Zone Ventilation %Demand Override 7% (adj)	0
					X	If RA Damper Position > RA Damper Position Min + 10% (adj), decrease the Zone Ventilation %Demand Override by 5% (adj)	0
				X		**Mixed Air Preheat Coil HHW Valve**	0
				X		Follow the Preheat Valve [Electric Preheat] sequence provided in “Detailed Sequence for OAU”, sequence 2.1.1	0
				X		Heat Request = True if ANY of the following are True	0
				X		Heat Mode = True and Mixed Air Preheat Valve > 10% Open (adj)	0
				X		Freeze Prevention = True and Mixed Air Preheat Valve > 10% Open (adj)	0
				X		Freeze Protection = True	0
				X		If Low Limit Switch (Freeze Stat) is installed anywhere in the AHU’s main air stream and the Low Limit Switch Trips, then do the following:	0
				X		Open the Preheat Valve 50% (adj) and issue Call for Heat and Medium Priority Alarm	0
				X		Return to Normal when Low Limit Switch is reset	0

				X		*If the AHU is served with OA from direct ducted OA intake that depends on the AHU Fan to induce outside air flow through the OA duct then do the following:* Open the Preheat Valve to 50% (adj) and issue Medium Level Alarm if ALL are True: OAT < 39F (adj) Any temperature sensor in the AHU main air stream < 39F (adj) Return to Normal when temperatures return to normal with a 2°F (adj.) Deadband	0
				X		**Mixed Air Preheat Coil Electric Duct Heater**	0
				X		Follow the Preheat Coil Electric Duct Heater sequence provided in "Detailed Sequence for OAU", sequence 2.1.1	0
					X	**Cooling Coil CHW Valve**	0
					X	If Cooling Coil CHW is the primary source of cooling in an AHU equipped with Secondary Cooling[19] then check Cooling Available[20] to determine which coil to use for cooling.	0
					X	If Cooling Available = True	0
					X	Enable Cooling Coil CHW Valve to operate according to the sequence below	0
					X	If Cooling Available = False	0
					X	Disable Cooling Coil CHW Valve control and close the valve, except for Freeze Prevention or Freeze Protection	0
					X	Min Cooling DAT SP = 55°F (adj)	0
					X	If Dehumidify = True, then Max Cooling DAT SP = 57°F (adj)	0
					X	Else Max Cooling DAT SP = 65°F (adj)	0
					X	Limit the CHW Valve position as DAT falls below Design DAT (per Design Documents, adj)	0
					X	If DAT is >/= Design DAT - 1°F (adj), Max CHW Valve Position = 100%	0
					X	If DAT is </= Design DAT - 3°F (adj), Max CHW Valve Position = 50% (adj)	0
					X	Avg.CSP = Average of all Space Temperature Cooling Setpoints for the associated AHU	0
					X	Min.CSP = Minimum of all Space Temperature Cooling Setpoints for the associated AHU	0
					X	Controlling CSP = (Avg.CSP + N*Min.CSP)/(N+1)	0
					X	If AHU Cooling Mode = True	0
					X	Modulate the CHW valve to maintain Discharge Air Temperature at Cooling DAT SP	0
					X	Upon transition from disabled to enabled, the DAT SP = Max DAT SP	0
					X	Adjust the DAT SP between Min and Max as follows:	0

[19] See DEFINITIONS AND STARTING VALUES for Secondary Cooling definition
[20] See DEFINITIONS AND STARTING VALUES for Cooling Available definition

					X	Every 5 Minutes (adj)	0
					X	If Controlling Space T > Controlling CSP + 0°F (adj) then decrease DAT SP by 1°F (adj)	0
					X	If Controlling Space T < Controlling CSP - 2°F (adj) then increase DAT SP by 1°F (adj)	0
					X	Else, CHW Valve = Closed	0
					X	Upon Unit Disable, the valve shall close at a rate of 10% (adj) per minute until it is fully closed. Example: If the valve is 47% open when the unit goes from Enabled to Disabled, the valve will begin to close at rate of 4.7% per min until it is fully closed.	0
					X	*If the AHU is served with OA from direct ducted OA intake that depends on the AHU Fan to induce outside air flow through the OA duct then do the following:* Open the CHW Valve to 50% (adj) and issue Medium Level Alarm if ALL are True: OAT < 39F (adj) Any temperature sensor in the AHU main air stream < 39F (adj) Return to Normal when temperatures return to normal with a 2°F (adj.) Deadband	0
					X	If Low Limit Switch (Freeze Stat) is installed anywhere in the main air stream, then do the following: Open the CHW Valve 50% (adj) and issue Medium Priority Alarm if Low Limit Switch (Freeze Stat) is tripped, manual reset required. Return to Normal when Low Limit Switch is reset	0
					X	Activate a CHW Valve Low Priority Alarm if the DAT from the CHW coil is less than Design DAT = (Design DAT per design documents, adj) for more than 30min (adj).	0
					X	**Cooling Coil Staged DX**	0
					X	*Note: This section applies to systems without packaged control, otherwise use packaged DX control means for compressor staging*	0
					X	If Cooling Coil Stage DX is the secondary source of cooling in an AHU equipped with Secondary Cooling[21] then check Cooling Available[22] to determine which coil to use for cooling.	0
					X	If Cooling Available = True	0
					X	Disable Cooling Coil Staged DX	0
					X	If Cooling Available = False	0
					X	Enable Cooling Coil Staged DX to operate according to the sequence below.	0
					X	Avg.CSP = Average of all Space Temperature Cooling Setpoints for the associated AHU	0

[21] See DEFINITIONS AND STARTING VALUES for Secondary Cooling definition
[22] See DEFINITIONS AND STARTING VALUES for Cooling Available definition

					X	Min.CSP = Minimum of all Space Temperature Cooling Setpoints for the associated AHU	0
					X	Controlling CSP = (Avg.CSP + N*Min.CSP)/(N+1)	0
					X	If AHU Cooling Mode = True & Chilled Water Available = False	0
					X	Stage DX Cooling Coil to maintain Controlling Space T at Controlling CSP as follows	0
					X	Set ZV%DO = 100% (adj)	0
					X	Every 5 Minutes (adj)	0
					X	If Controlling Space T > Controlling CSP + 0°F (adj) then increase Cooling Stage by 1 (adj)	0
					X	If Controlling Space T < Controlling CSP - 2°F (adj) then decrease Cooling Stage by 1 (adj)	0
					X	Else, DX Cooling Stage = 0	0
						END OF DETAILED SEQUENCE	

Detailed Sequence for SD VAV Zone Control

	Child Zone Reheat	Fan Powered	HW Reheat	Default	**SINGLE-DUCT VARIABLE AIR VOLUME UNIT (SD VAV) ZONE TERMINAL UNITS (CVB, VV, etc.)**	**Revision History**
					General	0
					Include Damper in AHU DP SP Reset = “Yes” or “No” (operator adjustable)	0
					Include Zone T in CC DAT SP Reset = “Yes” or “No” (operator adjustable)	0
				X	**Enable/Disable**	0
				X	Enable the unit if ANY are True	0
				X	Occupied Schedule Active	0
				X	Optimum Start Active	0
				X	Unoccupied AHU Cooling is True *(Note: the intent of this line is to start all zones served by a SDVAV AHU that goes into Unoccupied Cooling Mode even if the zone temperature is below the Unoccupied Cooling SP, to reduce the risk that the AHU would trip in high static while in Unoccupied Cooling mode)*	0
				X	Unoccupied Zone Cooling is True	0
				X	Unoccupied Zone Heating is True	0
				X	Manual Override is Active	0
				X	Override Time = 2 hours (adj)	0
				X	Associated AHU is Enabled	0
				X	**Zone Mode Control**	0
				X	Zone CSP = 74°F (adj)	0
				X	Zone HSP = 68°F (adj)	0
				X	Min (CSP – HSP) Offset = 3°F (adj)	0
				X	Unoccupied Zone CSP = 95°F (adj.)	0

				X	Unoccupied Zone HSP = 50°F (adj.)	0
				X	Unoccupied Zone Cooling is True if Space T rises above the Unoccupied Cooling Setpoint + 2°F (adj), False if Space T is below Unoccupied Cooling Setpoint	0
				X	Unoccupied Zone Heating is True if Space T falls below the Unoccupied Heating Setpoint - 2°F (adj), False if Space T is above Unoccupied Heating Setpoint	0
				X	Enter Ventilate Mode whenever unit is Disabled	0
				X	Enter Cooling Mode if ALL are True for 1 minute (adj)	0
				X	Unit is Enabled	0
				X	Ventilate Mode = True	0
				X	Space T > Zone CSP – 1°F (adj)	0
				X	If Cooling Mode = True	0
				X	Return to Ventilate Mode if ALL are True for 5 minutes (adj)	0
				X	AHU Dehumidify = OFF	0
				X	Space T < Zone CSP – 1.5°F (adj)	0
				X	Return to Ventilate Mode if ALL are True for 5 minutes (adj)	0
				X	AHU Dehumidify = ON	0
				X	Space T < Zone CSP – 2°F (adj)	0
				X	Enter Heating Mode if ALL are True	0
				X	Unit is Enabled	0
				X	Ventilate Mode = True	0
				X	Space T < Zone HSP - 0°F (adj)	0
				X	If Heating Mode = True	0
				X	Return to Ventilate Mode from Heating Mode if the Space T > Zone HSP + 1°F (adj)	0
				X	**Zone Primary Air Damper Control**	0
				X	Design Max CFM SP = Adjustable Value per design documents	0
				X	Design Min CFM SP = Adjustable Value per design documents	0
				X	Ventilation Min CFM = ZV%DO * Design Max CFM (*Note: ZV%DO is determined at the AHU level and broadcast to all terminal boxes*)	0
				X	Dehumidification Min CFM = 0% (adj) * Design Max CFM * AHU Dehumidification Mode status (On = 1, Off = 0)	0
				X	Flow cross k factor = (per box manufacturer, adj)	0
				X	Box Size = (per design)	0
				X	Flow cross calibration constant = (per TAB, adj)	0
				X	Max Zone Primary Air Flow SP = Design Max CFM	0
				X	If Zone Cooling Mode is True	0
				X	Min Zone Primary Air Flow SP is the greater of the following:	0
				X	Design Min CFM	0
				X	Ventilation Min CFM	0
				X	Dehumidification Min CFM	0
				X	Adjust Zone Primary Air Flow SP between Min and Max to maintain Space T at CSP	0
				X	Else Zone Primary Air Flow SP = Min Zone Primary Air Flow SP	0

				X	Where Min Zone Primary Air Flow SP is the greater of the following:	0
				X	Design Min CFM	0
				X	Ventilation Min CFM	0
				X	Modulate Primary Air Damper to maintain Zone Primary Air Flow SP using tuned proportional-integral control with adjustable P, I, Deadband, and Bias values	0
			X		**Zone HHW Valve [Electric Heat]**	0
			X		Min Zone Heating SAT SP = 75F (adj)	0
			X		Max Zone Heating SAT SP = 95F (adj)	0
			X		If Zone Heating Mode is True	0
			X		Modulate the HHW valve to maintain SAT at Heating SAT SP using proportional-integral control	0
			[X]		[Modulate SCR or control heating stages to maintain SAT at Heating SAT SP using proportional-integral control or ON/OFF control with manufacturer-recommended delay (adj) for staging on/off control]	0
			X		Adjust Zone Heating SAT SP between Min and Max, using proportional-integral control to maintain Space T at HSP	0
			X [X]		Else Close the HW Valve [Heat OFF]	0
		X			**Fan Speed Control – Series Only**	**0.7**
		X			Max Box Fan Speed = 100% (adj) *Note: the actual maximum will be determined during test & balance to correspond with maintaining a neutral box at design cooling primary air flow.*	0.7
		X			Min Box Fan Speed = 80% (adj) *Note: the actual minimum will be determined during test & balance to correspond with maintain a neutral box at the design heating air flow rate through the box or the minimum required to maintain adequate throw from room airflow diffusers.*	0.7
		X			Min Box Airflow SP (cfm) = Min Box Fan Speed (%) * Design Max Airflow SP (cfm)	0.7
		X			If Cool Mode = True then adjust the Fan Speed linearly per the reset table below:	0.7
		X			Primary Airflow SP → Box Fan Speed	0.7
		X			Design Max Airflow SP Max Box Fan Speed	0.7
		X			Min Box Airflow SP Min Box Fan Speed	0.7
		X			If Cool Mode = False then Fan Speed = Min Box Fan Speed	0.7
		X			**Fan Control – Series [Parallel]**	0
		X			If ANY are True then run the Fan, otherwise the Fan is OFF	0
		X			Occupied [Occupied & Heating Mode]	0
		X			Unoccupied Setback Heating	0
		X			Unoccupied Setback Cooling [Not for Parallel fan]	0
		X			Start the fan prior to starting AHU Fan [Start the fan only when zone is in Heating Mode and Occupied]	0
		X			If unoccupied set-back (heating) is activated, then enter heating mode using unoccupied heating setpoint but do not start the AHU	0

		X			If unoccupied set-up (cooling) is activated, then enter cooling mode using unoccupied cooling setpoint prior to starting AHU fan	0
					END OF DETAILED SEQUENCE	

GROUP 2 – FRESH AIR AND EXHAUST SYSTEMS

GENERAL

System Types

This section covers all Fresh Air and Exhaust Systems and is divided into three sections.

- Fresh Air Systems – systems that mechanically or passively provide outside air for the purpose of meeting ventilation standards, building pressurization needs, make-up air for application specific exhaust such as kitchen hoods, kiln hoods, laboratory hoods, etc., and any other outside air intake system that is controlled and/or monitored by the BMCS.
- Exhaust Air Systems – systems that mechanically or passively remove or eject indoor air to the outside such as restroom exhaust fans, kitchen hoods, kiln hoods, laboratory hoods, etc. and any other apparatus that is intended to remove air from the building or provide a path for air to be removed from the building and is controlled and/or monitored by the BMCS.
- Packaged Fresh Air & Exhaust Systems – systems that include integrated Fresh Air and Exhaust Air means such as Heat Recovery Units and any other Fresh Air and Exhaust system that is designed and packaged to operate as a single unit and is controlled and/or monitored by the BMCS.

The following table summarizes the types of Fresh Air and Exhaust Systems that are included in this section, this list will be expanded as new Fresh Air and Exhaust Systems are encountered.

System/Equipment	Section	Sequence
Outside Air Unit (OAU's and OAHU's) including "piggy-back" OAU's	2.1 – Fresh Air Systems	2.1.1
Supply Fan (SF) with Preheat Coil	2.1 – Fresh Air Systems	2.1.1
AHU Outside Air, Return Air, Relief Air Dampers	2.1 – Fresh Air Systems	2.1.2
Restroom Exhaust Fan	2.2 – Exhaust Air Systems	2.2.1
General Exhaust Fan	2.2 – Exhaust Air Systems	2.2.1
Kiln Room Exhaust Fan	2.2 – Exhaust Air Systems	2.2.2

Laboratory Classroom, Prep Room, Classroom Purge, and Fume Hood Systems	2.2 – Exhaust Air Systems	2.2.3
Other Exhaust-Only Systems (Dishwasher, Laundry, Etc.)	2.2 – Exhaust Air Systems	2.2.4
Kitchen Hood & Make-up Air Unit (MAU)	2.3 – Paired Fresh Air & Exhaust Systems	2.3.1
Heat Recovery Units (HRU)	2.3 – Paired Fresh Air & Exhaust Systems	2.3.2

Interlocks

Unless otherwise instructed in the Detailed Sequence or in the site-specific drawings and specifications, OA dampers shall be interlocked with associated fan operation via hardwired end-switch interlock with Fan enable circuit. OA Fans and dampers shall also be software interlocked with cooling and/or heating source availability. Some fresh air systems are equipped with a Freeze Stat that is hardwire interlocked via the safety circuit of associated fan starter, located per plans and specifications, and shall be set to operate at 34°F.

Unless otherwise instructed in the Detailed Sequence or in the site-specific drawings and specifications, close the outdoor air dampers when the related HVAC unit supply or exhaust fan is de-energized. Outdoor air damper shall be fully opened and proven open by hardwired actuator end switch or potentiometer feedback before related air handling unit fan is energized for 100% outside air use.

Provide motorized outside air dampers for the following:

- OA Supply Fans
- OAHU’s
- Exhaust Fans (except kitchen exhaust)

Unless otherwise instructed in the site-specific drawings and specifications, the following Exhaust/Supply Fans interlocks shall apply:

- Interlock the related exhaust and supply fans and the related outside air damper.
- Interlock the exhaust fans with the related air-handling unit through software.
- Interlock related exhaust fan for dishwasher with time delay off relay.
- Interlock related exhaust fan for kiln with manual timer switch and local line voltage temperature switch, to run fan if timer switch is activated OR if the temperature in the room rises above setpoint.
- Interlock kitchen hood related supply and exhaust fans.
- Provide additional interlocks as indicated on fan schedule and on drawings.
- Interlock electrical and mechanical room exhaust fans with thermostat.

- Interlock refrigerant monitor with mechanical room purge system.
- Interlock science room related supply and exhaust fans.
- Interlock outside air supply fans for VAV air-handling unit with air-handling unit status point.

Freeze Protection

Unless otherwise instructed in the Detailed Sequences or elsewhere in the site-specific drawings and specifications, the following general freeze protection rules shall apply.

Outside Air Handling Units & Supply Fans with heating and/or cooling coils: If unit is in occupied or unoccupied mode, upon the triggering of low limit temperature sensor (Freeze Stat), the system will be disabled, close the outside air damper, open heating and/or cooling valves to 50% (adj.). Low Limit Switch (Freeze Stat) shall be hard-wired with multi-pole single-throw switch with one switch leg hard-wired (interlocked) to close the outside air damper and de-energize the outside air fan and one switch leg to signal the BMCS.

2.1 – FRESH AIR SYSTEMS

General

This section includes all outside air systems for general ventilation including OAHU's, SF with PHC, PHC alone, and any other forced air ventilation equipment used for general ventilation of the facility. It does not include specialty systems such as Kitchen Hood MAU's, Lab Hood MAU's, etc.

In general, Fresh Air and Exhaust systems shall be associated with operation of an AHU, for the purposed of providing fresh air for occupants and positive building pressure control. Fresh Air and Exhaust shall be enabled whenever the associated AHU is ON and the General OA Schedule[23] is ON, otherwise the Fresh Air System shall remain OFF. If an associated AHU is ON due to an Unoccupied mode of operation, such as summertime dehumidification or unoccupied setback, Fresh Air Systems shall remain disabled unless outside air conditions are favorable. Fresh Air should remain OFF if there is a potential for introducing freezing air and no heating is available. Fresh Air shall also remain OFF if there is a potential for condensation on interior surfaces and no cooling is available. Whenever fresh air intake is OFF, associated EF's shall remain OFF so as not to create a negative building pressure. If Fresh Air is being held OFF due to the above conditions, a Low Priority Fresh Air OFF Alarm shall be issued.

The general diagrams included in this section are for diagrammatic purposes only and includes points that may not be applicable to or needed for every system. Likewise, the sequence of operation includes instructions for components that may not be applicable to every system. However, the sequences are written so that elimination of components does not impact the operation of remaining components. Therefore, components that are not present may be treated as "Not Applicable".

Demand Controlled Ventilation (DCV) Using CO_2 Concentration Measurements

DCV is used to reduce outside air flow requirements as allowed by governing codes. Per ASHRAE 62.1 – 2022: "Where CO2 sensors are used for DCV, the CO2 sensors shall be certified by the manufacturer to be accurate within ±75 ppm at concentrations of both 600 and 1000 ppm when measured at sea level at 77°F (25°C). Sensors shall be factory calibrated and certified by the manufacturer to require calibration not more frequently than once every five years. Upon detection of

[23] If "OA Shutdown Schedule" is used in lieu of "General OA Schedule" then the logic must be reversed as described in the Definitions section under "General OA Schedule" and "OA Shutdown Schedule"

sensor failure, the system shall provide a signal that resets the ventilation system to supply the required minimum quantity of outdoor air (Vbz) to the breathing zone for the design zone population (Pz)."

In this specification, DCV is achieved by monitoring the CO_2 concentration at locations described herein to maintain the required ventilation in the breathing zone. To achieve this, the outside air CO_2 concentration and flow rate must be considered, the CO_2 generation rate of the occupants must be considered, the resulting CO_2 concentration in the breathing zone under fully occupied conditions must be considered, and the CO_2 concentration must be monitored for at least one of the following three locations: Space CO_2 ppm, Return Air CO_2 ppm, or Mixed Air CO_2 ppm.

Note: this should only be applied to areas where the predominant ventilation requirement variable is occupancy. It should not be used in applications where ventilation rate is determined by anything other than occupancy and a small amount of "other" ventilation rate requirements that are considered constant in nature and can be accounted for by setting a minimum ventilation rate to meet these constraints.

Space CO_2 ppm is the preferred method, as long as the measurement is taken within the breathing zone of the space. This location results in a direct measurement of the breathing zone CO_2 concentration, and therefore provides a direct indication of the outdoor air flow rate as long as the CO_2 generation rate (N, in cfm/person) is known, using the following equation:

$V_O = N / (C_S - C_O)$

where:
V_O = outdoor airflow rate, cfm per person
N = CO_2 generation rate, cfm per person
C_S = CO_2 concentration in the space, ppm
C_O = CO_2 concentration in the outdoor air, ppm

Return Air CO_2 ppm is frequently used in lieu of Space CO_2 when measurement of Space CO_2 within the breathing zone is not practical or when there are multiple rooms being served and measurement within each zone would result in an unreasonable number of sensors to install and maintain. When using RA CO_2 for DCV, it is important to account for ventilation efficiency (variations in the efficiency with which outdoor air is distributed to the occupants) as well as variations in occupant density that may occur across various zones served at different times of the day. To do this, the OA CO_2 concentration and flow rate should be considered, and a RA CO_2 concentration should be maintained that will result in a delivered concentration (or supply air concentration) less than or equal to the delivered concentration under design conditions to maintain the required ventilation air to the breathing zone within each occupied space.

Mixed Air CO_2 ppm may be used in lieu of RA CO_2 when a reliable measurement of RA CO_2 ppm is not practical, such as when and AHU with open return is located in mechanical room with multiple return air openings from various zones, or mixtures of RA from areas served by different AHU's, and there may be other examples. When using MA CO_2 for DCV, it is important to account for ventilation efficiency (variations in the efficiency with which outdoor air is distributed to the occupants) as well as variations in occupant density that may occur across various zones served at different times of the day. To do this, the OA CO_2 concentration and flow rate should be considered, and a MA CO_2 concentration should be maintained that will result in a delivered concentration (or supply air concentration) less than or equal to the delivered concentration under design conditions to maintain the required ventilation air to the breathing zone within each occupied space.

CO_2 Concentration Setpoint Determination Procedure for SZU and MZU AHU's

Perform the following test to determine the appropriate delivered air (supply air) CO_2 concentration to maintain the required breathing zone CO_2 concentration at or below the breathing zone concentration that corresponds with design occupancy with design outdoor air ventilation rate.

1. With AHU running and Supply Fan Speed = 100% and OAHU Fan Speed = 100%, measure the amount of OA being provided to make sure it is equal to the design amount.
2. Make adjustments to OAHU Supply Fan Speed as necessary to achieve 100% OA according to design documents. Note: it is assumed that the design amount of OA was determined using the an accepted standard for OA ventilation rates.
3. Measure MA CO_2 with 100% OA and Supply Fan Speed = 100%, 30 min after the start of the first class in the morning, or after the measured MA CO_2 no longer changes significantly (10%) over a 10 minute period, whichever is longer. The measured CO_2 concentration will be the Max CO_2 Setpoint. Note: to achieve a more conservative setpoint, reduce Max CO_2 Setpoint by 10% from what is measured in this step to account for measurement errors.
4. Reduce the AHU Fan Speed to 80% (or the expected Min Fan Speed in the application) and measure MA CO_2. The measured CO_2 concentration will be the Min CO_2 Setpoint. Note: This step needs to start (reduction in fan speed) at the beginning of a class period when classrooms are full of students and the MA CO_2 concentration measurement should be taken at least 30 minutes after the start of class, or after the measured MA CO_2 no longer changes significantly (10%) over a 10 minute period, whichever is longer. Note: as in the previous step, a more conservative Min CO_2 Setpoint would be 10% below what is measured in this step.
5. **Program the system to change the MA CO_2 Setpoint linearly from Min to Max (determined above) as the AHU Supply Fan Speed goes from Min Fan Speed to 100%.** Note, these settings should not change if the Minimum Speed is changed. For example, if the Min Fan Speed is adjusted by the user, then the corresponding MA CO_2 setpoint would continue to change linearly with fan speed as the fan speed is changes according to the original linear equation determined in this step.
6. **Set the Minimum OAHU Fan Speed setting equal to the ventilation rate required by the following equation: $R_a \times A_z$, where R_a = 0.12 cfm/ft2, A_Z = Floor Area of the area served by the AHU.** Note: this can be done by setting the AHU Supply Fan Speed to Min Supply Fan Speed and measuring the OA flow rate with the OAHU at 100% speed and then calculating the Min OAHU Fan Speed using the Fan Laws, a reduction in air flow rate is proportional to the reduction in fan speed for an unchanging system curve.
7. Modulate the amount of OA (in this case it will be OA Fan Speed) to maintain measured MA CO_2 concentration at MA CO_2 Setpoint.
8. As an added check, measure the CO_2 level in the breathing zones of each classroom 30 minutes (or longer) after the start of class to make sure the measured values are equal to or less than the concentration determined by the following equation (no greater than 10% above):

   $C_S - C_O = N / V_O$

   Where:
   VO [cfm/person] = AHU Design OA CFM / Pz
   If VO was calculated using ASHRAE 62.1-2004 or later then:
   AHU Design OA CFM = Vbz / Ev , Ev = 0.75, Vbz = RP Pz + Ra Az (Eq. 6.2.2.1, ASHRAE 62.1)
   N = 0.0105 cfm of CO2 per person (seated, doing light desk work)
   CS – CO = CO2 concentration in the space relative to OA concentration, volume fraction

   Note 1: to obtain ppm, multiply answer by 1,000,000
   Note 2: this equation should only be used for measurements taken after the zone has been fully occupied for at least 30 minutes to allow the concentration to reach steady state.
   Note 3: this method assumes that listed design OA cfm for each MZU meets or exceeds cfm required of the then-current ASHRAE 62.1 standard and that rooms have been properly balanced to meet design air flow rates and design OA cfm per the original design documents. Resulting expected levels of CO2 only indicate what is expected based on the listed assumptions and the original design outdoor air ventilation rates, they are not expected to fit any other accepted standard or acceptable levels. There are many factors that may influence this calculation including but not limited to the assumed CO_2 emission rate per person, so results like this are best double-checked by field measurement and appropriate adjustments made to MA CO_2 setpoint.

Example: AHU-1-9 has a design OA of 3,780 CFM. The AHU is designed for 12,400 CFM. The OA fraction is 3,780 / 12,400 = 0.305, or 30.5% OA. In one classroom we count twenty-five (25) people and four (4) supply registers at 200 CFM/register, or 800 CFM supply, equating to 800 * 0.305 = 244 CFM of OA, so V_O in that classroom = 244 / 25 = 9.76 CFM/person. Therefore, we would calculate $C_S - C_O$ = 0.0105 / 9.76 = 0.001076 * 1,000,000 = 1076 ppm. If the OA CO_2 concentration is measured to be 350 ppm, then C_S should be no greater than 1426 ppm in the breathing zone. At least a 10% safety factor should be applied to the resulting MA CO_2 concentration setpoint to account for any measurement errors.

If the measured CO_2 is greater than the calculated value for classroom concentration, then check the following:
- Airflow to the classroom meets or exceeds original design.
- OA airflow to the AHU meets or exceeds original design.

If either of the above does not meet the original design, then make necessary corrections if possible and then re-test.

OAHU2.1.1 – OUTSIDE AIR HANDLING UNIT (OAHU)

General

This section includes all outside air systems for general ventilation including OAHU's, SF with PHC, PHC alone, and any other forced air ventilation equipment used for general ventilation of the facility. It does not include specialty systems such as Kitchen Hood MAU's, Lab Hood MAU's, etc. See section 2.1.2 for control of dampers that are installed on AHU's (such as OA Dampers, RA Dampers, and EA Dampers) and that operate in conjunction with outside air equipment or are directly ducted to the outside, not to be confused with OA and EA dampers that are installed on OAHU's, covered in this section.

Humidity Control Units (HCU)

A Humidity Control Unit (HCU) is typically a packaged unit capable of producing very low dewpoint temperatures that is self-contained with multiple stages of DX Cooling, Hot Gas Reheat, and may or may not include additional reheat (electric, natural gas, hot water, etc.), heat recovery, enthalpy exchanger, relief air fan, etc. and monitors indoor air humidity and/or dewpoint temperature and in turn conditions outside air or return air from the conditioned space(s) to the space or to the return air plenum of AHU's serving the space.

The unit has on-board controls that sequence the equipment included in the unit to maintain supply air temperature and supply air dewpoint temperature at an adjustable setpoint. The supply air temperature and dewpoint setpoints are adjusted to maintain indoor air conditions within a specified range.

If an HCU is present then the BAS shall provide supervisory control of the unit via hardwired control points and/or BACnet interface as specified in the project-specific design documents, and shall provide the following monitoring and control at a minimum. A dedicated Sequence Page shall be provided for each HCU detailing the following sequence per the Sequence Testing & Tuning Pages Guiding Principals.

HCU Indoor Air dpT SP = 56°F (adj)
Max HCU Discharge Air dpT SP = 65°F (adj)
Min HCU Discharge Air dpT SP = 55°F (adj)

If HCU Indoor Air dpT > HCU Indoor Air dpT SP + 1°F (adj) then HCU Dehumidify = ON
If HCU Indoor Air dpT < HCU Indoor Air dpT SP - 1°F (adj) then HCU Dehumidify = OFF
If HCU Dehumidify = ON upon unit start then Starting HCU Discharge Air dpT SP = 55°F (adj)

If HCU Dehumidify = OFF upon unit start then Starting HCU Discharge Air dpT SP = 65°F (adj)

If All of the following are True then HCU = ON & HCU Mode = OA
- General OA Schedule = ON
- Any Associated AHU = Occupied (*list all*)
- Same Associated AHU Fan = ON (*list all*)

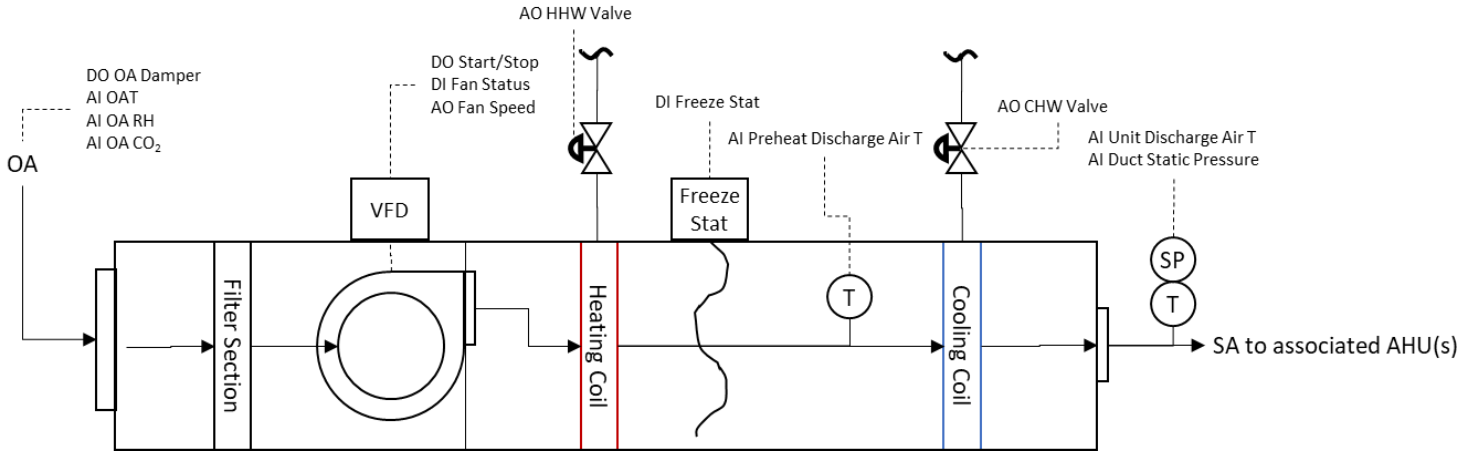
If All of the following are True then HCU = ON & Mode = RA
- General OA Schedule = OFF
- Any Associated AHU = Occupied (*list all*)
- Same Associated AHU Fan = ON (*list all*)
- HCU Dehumidify = ON

If HCU = ON then do the following
- Adjust the HCU Discharge Air dpT every 1 minutes (adj)
- If HCU Indoor Air dpT > HCU Indoor Air dpT SP + 1°F (adj) then decrease HCU Discharge Air dpT SP by 1°F (adj)
- If HCU Indoor Air dpT < HCU Indoor Air dpT SP - 1°F (adj) then increase HCU Discharge Air dpT SP by 1°F (adj)

If HCU = ON & HCU Mode = OA then
- *See Outside Air Handling Unit (OAHU) Detailed Sequence, Section 2.1.1 for all elements not included in this section.*

If HCU = ON & HCU Mode = RA then
- *See Single Zone Unit (SZU) Detailed Sequence, Section 1.1.1 for all elements not included in this section.*

Provide BACnet integration and separate graphic page to list all integrated points (read only). The integrated points shall include, at a minimum: all air condition measurement points, all alarm points, all equipment status points, all active control setpoints, active mode of operation. All air condition values shall also be displayed on the unit graphic.



Detailed Sequence for OAHU

Outside Air Fan	Exhaust Air Fan	Heat Recovery	OA Damper	EA Damper	Preheat	Precool	Reheat	Default	**OUTSIDE AIR HANDLING UNITS (Covers Dampers, OAHU, OAU, OA Fan, AHU Pretreat Section, Integrated Exhaust Fan, Heat Recovery, etc.)** *Note: The applicable detailed sequences in this section should be separate from any associated Group 1 AHU even if the equipment is integral to the associated AHU (example, piggy-back OAU) and shown on its own graphic page.*	Revision History
									General	**0**
								X	*General Notes:* *1. All OAT and OA dpT's referred to in this sequence are the global information from the central sensor(s) quality-control checked with weather station data, not the temperature sensor mounted at the inlet to the OAU that is used for diagnostic purposes only.*	0
								X	*2. For units provided with integrated controls for internal components, such as DX-OAHU with Hot Gas Reheat, the BMCS shall provide supervisory control of the unit as necessary to follow this detailed sequence where applicable.*	0
								X	*3. This section provides definitions for variables that are used elsewhere in other sections and/or sequences.*	0
					X				*For HW Heating*: see Heating Available definition in Definitions section	0
					X				*For HW Heating*: Heat Request = True when ANY of the following are True	0
					X				Freeze Prevention is True and Hot Water Valve > 10% Open (adj) [*NOTE: this statement is for freeze prevention purposes*]	0
					X				OAHU is Enabled and Heat Mode = True	0
					X				Freeze Protection = True	0
		X							For Heat Recovery: Heating Available = True if ALL are True	0
		X							Exhaust Air Fan = ON	0
		X							Heat Recovery Wheel = ON (if applicable)	0
					X				Freeze Prevention is True if ALL are True	0
					X				OAT < 39F (adj), with 1°F (adj) dead band	0
					X				Heating Available is False	0
						X			For CHW Cooling: *See Cooling Available definition in Definitions section*	0
						X			For CHW Cooling: Cool Request = True if ALL are True	0
						X			Cool Mode = True	0
						X			OAHU is Enabled	0

		X							For Heat Recovery without CHW Cooling: Cooling Available = True if ALL are True	0
		X							Exhaust Air Fan = ON	0
		X							Heat Recovery Wheel = ON (if applicable)	0
						X			Condensation Prevention is True if ALL are True	0
						X			OA dewpoint T > 80F (adj), with 1°F (adj) dead band	0
						X			Cooling Available is False	0
								X	**Enable/Disable**	0
								X	Enable when ALL are True	0
								X	General OA Schedule[24] = ON	0
								X	Associated AHU Occupied	0
								X	Associated AHU Economizer = OFF *Note: This applies only to units that serve an associated AHU with separate Economizer Damper where the Economizer OA is ducted separately to the associated AHU and the OAHU supplies only minimum OA when Associated AHU Economizer is OFF.*	0.8
								X	Optimal Start Active = False	0
								X	Associated AHU Fan ON* * *Eliminate this condition if OAHU is ducted directly to space independent of associated AHU ductwork*	0
								X	Disable the unit when ANY are True	0
								X	ANY of the Enable conditions are False	0
								X	Load Sheld Level 1 is True and Load Shed Exclude is False	0
								X	**Mode**	0
								X	Enter Ventilation Mode whenever the unit is Disabled	0
						X			Enter Cooling Mode if OAT > 65°F (adj), Cool Mode SP	0
						X			Return to Ventilate Mode if OAT < Cool Mode SP - 5°F (adj)	0
					X				Enter Heating Mode if ANY are True	0
					X				OAT < 45°F (adj), Heat Mode SP	0
					X				Preheat Coil DAT < Heat Mode SP	0
					X				Return to Ventilate Mode if ALL are True	0
					X				OAT > Heat Mode SP + 5°F (adj)	0
					X				Preheat Coil DAT > Heat Mode SP + 5°F (adj)	0
			X						**2-Position OA Damper**	0
			X						*In addition to the sequence below, follow applicable portion(s) of Detailed Sequence under Section 2.1.2*	0
			X						Enable the damper when ALL of the following are True	0

[24] If "OA Shutdown Schedule" is used in lieu of "General OA Schedule" then the logic must be reversed as described in the Definitions section under "General OA Schedule" and "OA Shutdown Schedule"

			X						OAHU is Enabled	0
					X	X			Freeze Prevention = False	0
					X	X			Freeze Protection = False	0
						X			Condensation Prevention = False	0
			X						Else Disable the damper	0
								X	If OA Damper is Enabled, then do the following	0.4
								X	Open the OA Damper	0.4
			X						If Low Limit Switch (Freeze Stat) is ON then Close the Damper, this is a hardwired interlock. *Note: this is equivalent to "Freeze Protection"*	0
			X						**Modulating OA Damper**	0
			X						*In addition to the sequence below, follow applicable portion(s) of Detailed Sequence under Section 2.1.2*	0
			X						Allow the Modulating OA Damper to modulate when ALL of the following are True	0
			X						OAHU is Enabled	0
					X	X			Freeze Prevention = False	0
					X	X			Freeze Protection = False	0
						X			Condensation Prevention = False	0
			X						Else Close the damper	0
			X						If Low Limit Switch (Freeze Stat) is ON then Close the Damper, this is a hardwired interlock. *Note: this is equivalent to "Freeze Protection"*	0
X									**OA Fan Start/Stop**	0
X									Enable the Outside Air Fan when ALL applicable conditions are True *(Note: The OAHU Fan does not start just because the OAHU is Enabled, as per the conditions below.)*	0
X									OAHU is Enabled	0
X									OA Damper is Open**	0
X									** *OA damper Open end switch shall be wired to the fan motor starter or VFD damper enable circuit, and disable the fan if the damper is not fully open*	0
X									Freeze Prevention = False	0
X									Condensation Prevention = False	0
X									If Low Limit Switch (Freeze Stat) Alarm = False (this is also a hardwired interlock)	0
X									If OA Fan is Enabled, then do the following	0.4
X									*For units with Return Air CO_2 or Space CO_2 do the following*	0.9
X									If Controlling CO_2 > 800ppm (adj) the Start the Fan *Note: Setpoints to be determined that maintain breathing zone ventilation rate requirements.*	0.4

X									If Controlling CO_2 < 700ppm (adj) then Stop the Fan *Note: If Fan is OFF due to this condition, then display "DCV Active" on the AHU graphic*	0.4
X									*For units with Mixed Air CO_2 control do the following*	0.9
X									Min MA CO_2 Setpoint = TBD* (adj) **Determined using "CO_2 Concentration Setpoint Determination Procedure" in this specification.*	0.9
X									Max MA CO_2 Setpoint = TBD* (adj) **Determined using "CO_2 Concentration Setpoint Determination Procedure" in this specification.*	0.9
X									Set MA CO_2 SP according to the following linear reset: SZU/MZU Fan Speed* — MA CO_2 SP 100% — Max MA CO_2 SP 80% — Min MA CO_2 SP *Speed used in "CO_2 Concentration Setpoint Determination Procedure for SZU and MZU AHU's"	0.9
X									If Controlling MA CO_2 > MA CO_2 SP then Start the Fan	0.9
X									If Controlling MA CO_2 < MA CO_2 – 200 ppm (adj) then Stop the Fan *Note: If Fan is OFF due to this condition, then display "DCV Active" on the AHU graphic*	0.9
X									*For units without CO2 control do the following*	0.4
X									Start the Fan	0.4
X									If OA Fan is Disabled, the Stop the Fan	0.4
									OA Fan Speed	0
X									Max OA Fan Speed = 100% (adj), Note: This value may vary based on the detailed sequence of operation below.	0
X									Min OA Fan Speed = 33% (adj), *Note: This value may vary based on the detailed sequence of operation. The minimum value should be set greater than or equal to the value determined using the equation defined in Step 6 under "CO2 Concentration Setpoint Determination Procedure for SZU and MZU AHU's"*	0
X									If Fan has a VFD and NO Duct Static Pressure Sensor is present, then do the following	0
X									*For OA Fan serving Kitchen AHU:*	0.3

									Max OA Fan Speed = 100% * (Design EF CFM of kitchen EF's that are ON / Design EF CFM of all kitchen EF's *Note: provide list of EF's and associated Design EF CFM (adj) on the sequence page.*	
X									*For all other units:* Max OA Fan Speed = 100% * (Design OA CFM of units served that are ON / Design OA CFM of units served) *Note: provide list of AHU's served and associated Design OA CFM (adj) on the sequence page.*	0.3
X									If OAHU serves AHU(s) with no modulating OA damper(s), then do the following:	0
X									For application with NO PROCESS VARIABLE CONTROL, OA Fan Speed = Max OA Fan Speed	0
X									For application with CO_2 control, adjust the OA Fan Speed between Min and Max according to the following, every 5 minutes (adj)	0
X									*For Return Air / Space CO_2 Control*	0.9
X									While Controlling CO_2 > 1000 ppm (adj), increase the OA Fan Speed by 7% (adj)	0
X									While Controlling CO_2 < 800 ppm (adj), decrease the OA Fan Speed by 5% (adj)	0
X									*For Mixed Air CO_2 Control*	0.9
X									Min MA CO_2 Setpoint = TBD* (adj) **Determined using "CO_2 Concentration Setpoint Determination Procedure" in this specification.*	0.9
X									Max MA CO_2 Setpoint = TBD* (adj) **Determined using "CO_2 Concentration Setpoint Determination Procedure" in this specification.*	0.9
X									Set MA CO_2 SP according to the following linear reset: <u>SZU/MZU Fan Speed*</u> <u>MA CO_2 SP</u> 100% Max MA CO_2 SP	0.9

									80% Min MA CO_2 SP *Speed used in "CO_2 Concentration Setpoint Determination Procedure for SZU and MZU AHU's"	
X									If MA CO_2 ppm > MA CO_2 SP then increase the OA Fan Speed by 7% (adj)	0.9
X									If MA CO_2 ppm < MA CO_2 SP – 200 ppm (adj) then decrease the OA Fan Speed by 5% (adj)	0.9
X									If OAHU serves at least one unit with a modulating OA Damper, then do the following:	0
X									While ANY 2-pos. OA Damper(s) serving connected AHU(s) is(are) Open, OA Fan Speed = Max OA Fan Speed	0
X									While ALL 2-pos. OA Damper(s) serving connected AHU(s) are Closed and ANY Modulating OA Damper(s) serving AHU(s) is(are) Open, adjust the OA Fan Speed between Min and Max according to the following, every 5 minutes (adj)	0
X									While Max open connected Modulating OA Damper Position > 99% (adj), increase the OA Fan Speed by 5% (adj)	0
X									While Max open connected Modulating OA Damper Position < 90% (adj), decrease the OA Fan Speed by 3% (adj)	0
X									If Fan has a VFD and Duct Static Pressure Sensor is present, then do the following	0
X									Max Duct Static Pressure = 0.5 inwc (adj) – this will be determined during commissioning	0
X									Min Duct Static Pressure = 0.1 inwc (adj) – this will be determined during commissioning	0
X									Modulate Fan Speed to maintain Duct Static Pressure at Duct Static Pressure SP	0
X									If OAU serves at least one unit with a modulating OA Damper then do the following, otherwise hold Duct Static Pressure SP constant at Max Duct Static Pressure SP	0
X									While ANY 2-pos. OA Damper(s) serving connected AHU(s) is(are) Open, hold Duct Static Pressure SP constant at Max Duct Static Pressure SP	0

X									While ALL 2-pos. OA Damper(s) serving connected AHU(s) are Closed and ANY Modulating OA Damper(s) serving AHU(s) is(are) Open, adjust the Duct Static Pressure SP between Min and Max according to the following every 5 minutes (adj)	0
X									While Max open connected Modulating OA Damper Position > 99% (adj), increase the Duct Static Pressure SP by 0.2 inwc (adj)	0
X									While Max open connected Modulating OA Damper Position < 90% (adj), decrease the Duct Static Pressure SP by 0.1 inwc (adj)	0
					X				**Preheat Valve**	0
					X				Min Preheat DAT SP = 40°F(adj)	0
					X				Max Preheat DAT SP = 50°F(adj)	0
		X			X				If Heat Recovery is present and the Preheat source is located upstream of the heat recovery equipment, the process variable for DAT SP control shall be the temperature leaving the heat recovery equipment (HRU Discharge Air T), not the Preheat Coil Discharge Air T.	0
					X				If Heating Mode = True	0
					X				Modulate the Preheat Valve using proportional-integral control to maintain Preheat Coil DAT at Preheat DAT SP	0
					X				Set Preheat Valve Loop Bias = the result of the linear reset schedule below	0
					X				In: OAT Out: Loop Bias 50°F (adj) 0% (adj) 40°F (adj) 100% (adj)	0
					X				Upon Unit Disable, the HHW Valve shall close at a rate of 10% (adj) per minute until it is fully closed. Example: If the valve is 47% open when the unit goes from Enabled to Disabled, the valve will begin to close at rate of 4.7% per min until it is fully closed.	0
					X				Preheat DAT SP varies linearly between Min and Max Preheat DAT SP as follows:	0
					X				OAT >/= 40°F (adj), Preheat DAT SP = Min Preheat DAT SP	0
					X				OAT </= 30°F (adj), Preheat DAT SP = Max Preheat DAT SP	0
					X				While Unit is Disabled	0

					X				If Preheat Coil DAT falls below Freeze Prevention SP then do the following:	0
					X				Open the Preheat Valve to 50% (adj)	0
					X				Send Heat Request to Boiler Plant	0
					X				Return to normal when Preheat Coil DAT rises by 10F (adj)	0
					X				If Low Limit Switch (Freeze Stat) is ON	0
					X				Open HHW Valve 50%(adj)	0
					X				Send Heat Request to the Boiler Plant	0
					X				**Electric Preheat w/ SCR**	0
					X				Min Preheat DAT SP = 40°F(adj)	0
					X				Max Preheat DAT SP = 50°F(adj)	0
		X			X				*If Heat Recovery is present and the Preheat source is located upstream of the heat recovery equipment, the process variable for DAT SP control shall be the temperature leaving the heat recovery equipment (HRU DAT), replace "Preheat Coil DAT" with "HRU DAT" in the sequence below.*	0
					X				If Heating Mode = True	0
					X				Modulate the SCR using proportional-integral control to maintain Preheat Coil DAT at Preheat DAT SP	0
					X				Preheat DAT SP is as follows:	0
					X				OAT = 45°F (adj), Preheat DAT SP = Min Preheat DAT SP	0
					X				OAT = 35°F (adj), Preheat DAT SP = Max Preheat DAT SP	0
					X				**Staged Electric Preheat**	0
					X				Max Heating Stages = 1 (adj)	0
					X				Min Heating Stages = 0 (adj)	0
		X			X				*If Heat Recovery is present and the Preheat source is located upstream of the heat recovery equipment, the process variable for DAT SP control shall be the temperature leaving the heat recovery equipment (HRU DAT), replace "Preheat Coil DAT" with "HRU DAT" in the sequence below.*	0
					X				If Heating Mode = True	0
					X				Adjust the Heating Stages between Min and Max as follows, every 5 minutes (adj):	0
					X				If Preheat DAT < 40°F (adj), increase Heating Stage by 1 (adj)	0
					X				If Preheat DAT > 50°F (adj), decrease Heating Stage by 1 (adj) *Note: Check the expected temperature rise per stage and set the Decrease Heating Stage temperature setpoint so that one stage does not result in a*	0

									temperature higher than the setpoint, assuming the temperature entering the heater section is less than the Increase Heating Stage temperature setpoint.	
						X			**CHW Valve**	0
						X			Min Precool DAT SP = 60F(adj)	0
						X			Max Precool DAT SP = 65F (adj)	0
						X			In Cooling Mode	0
						X			Modulate the Cooling Valve using proportional-integral control to maintain Cooling Coil Discharge Air T at Precool SP	0
						X			Precool DAT SP = according to reset table below	0
						X			Min Precool DAT SP @ OA dpT = 70F (adj)	0
						X			Max Precool DAT SP @ OA dpT = 55F (adj)	0
						X			Else Valve is Closed	0
						X			Upon Unit Disable, the HHW Valve shall close at a rate of 10% (adj) per minute until it is fully closed. Example: If the valve is 47% open when the unit goes from Enabled to Disabled, the valve will begin to close at rate of 4.7% per min until it is fully closed.	0
						X			Set Cooling Valve Loop Bias = the result of the linear reset schedule below	0
						X			In: OA dpT Out: Loop Bias 70.0°F (adj) 0% (adj) 85.0°F (adj) 100% (adj)	0
								X	If Low Limit Switch (Freeze Stat) is ON	0
						X			Open CHW Valve 50%(adj)	0
								X	Send Call for CHWP to Chilled Water Plant	0
						X			Limit the CHW Valve position as DAT falls below Min Precool DAT SP	0
						X			If DAT is >/= Min Cooling DAT SP – 1°F (adj), Max CHW Valve Position = 100%	0
						X			If DAT is </= Min Cooling DAT SP – 3°F (adj), Max CHW Valve Position = 50% (adj)	0
								X	Activate a CHW Valve Low Priority Alarm if the DAT from the CHW coil is less than 50°F (adj) for more than 30min (adj).	0
									Staged DX Coil w/ Modulating Hot Gas Reheat	0
						X	X		*Note: This section applies to systems without packaged control, otherwise use packaged DX control means for compressor staging and Hot Gas Reheat control*	0
						X	X		In Cooling Mode	0
						X			Enable Cooling	0

						X	X		Set Supply Air Temperature Reset Signal as follows	0
						X	X		Precool DAT SP = Min to Max Precool DAT SP as OA dpT goes from 65F to 55F	0
						X	X		Min Precool DAT SP = 55F(adj)	0
						X	X		Max Precool DAT SP = 65F (adj)	0
						X	X		Else Disable Cooling	0
				X					**EA Damper**	0
				X					Open the EA damper when the OAU is Enabled	0
				X					Else Close the EA damper	0
	X								**EA Fan Start/Stop**	0
	X								Start the Exhaust Air Fan when ALL applicable conditions are True	0
	X								OAHU is Enabled	0
	X								Exhaust Air Damper = Open	0
	X								Else Stop the Exhaust Air Fan	0
	X								**EA Fan Speed**	0
	X								Max EA Fan Speed = 100% (adj), Note: This value may vary based on the detailed sequence of operation.	0
	X								Min EA Fan Speed = 33% (adj), Note: This value may vary based on the detailed sequence of operation.	0
	X								Modulate Fan Speed to track OA Fan Speed as follows	0
	X								EA Fan Speed = OA Fan Speed – 0% (adj)	0
		X							**Heat Recovery**	0
		X							See Section 2.4	0
									END OF DETAILED SEQUENCE	

2.1.2 – AIR HANDLING UNIT OUTSIDE AIR, RETURN AIR, AND RELIEF AIR DAMPER/FAN CONTROL

General

This section includes control of all AHU outside air dampers, return air dampers, and relief air dampers and stand-alone fans that are used for fresh air control and associated directly with a single AHU. It applies to all applicable AHU's included under GROUP 1 – ZONED AIR CONDITIONING & HEATING SYSTEMS. Note that in this case, the dampers and/or fans covered by this section are associated with a single AHU and should be shown on the graphic page with the associated AHU as their operation and operating "mode" align with the AHU's modes of operation, this is in contrast with OA equipment that includes heating and/or cooling modes that may conflict with an associated AHU's mode and therefore should always be shown on a separate graphic page.

AHU's With Two (2) OA Dampers, One (1) Minimum OA Damper and One (1) Maximum OA Damper

Some AHU's are equipped with two (2) OA Dampers instead of just one (1). In these cases, the Min OA Damper shall be treated as a 2-position OA Damper (no Process Variable Control) and the Max OA Damper shall be controlled according to the applicable part(s) of the Detailed Sequence in this section and as determined below.

- If actuator is modulating and a process variable is to be used for control of the damper then use Modulating OA Damper (with Process Variable Control)

- If actuator is modulating and no process variable is to be used for control of the damper then use Modulating OA Damper (no Process Variable Control)
- If the Max OA Damper is 2-position then the Max OA Damper shall be opened and closed based according to 2-position OA Damper (no Process Variable Control)
    - For Kitchen AHU's, he Max OA Damper shall open when any kitchen hood EF is ON and the kitchen AHU is Occupied and ON.

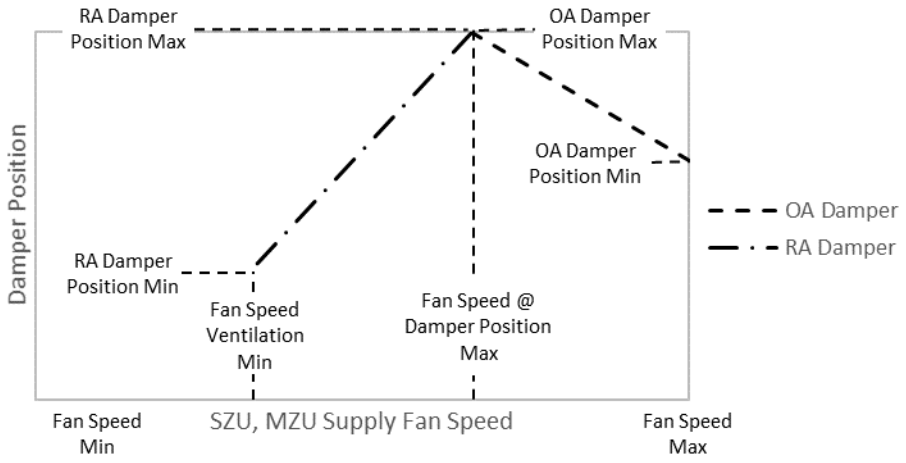
Modulating OA Damper (No Process Variable control) & Modulating RA Damper (no Process Variable Control) Position Determination Method & Testing Procedure

In instances where damper control is dependent on a process variable, such as measured airflow or CO2, the Detailed Sequences will "find" the appropriate balance by seeking to maintain the dependent process variable setpoint. In instances where no process variable is provided to which the operation can be controlled, we must determine through testing the required positioning of dampers over a range of operating conditions that will allow the required amount of fresh air to be introduced into the system. Therefore, this sub-section is provided as a supplement to the related Detailed Sequence(s) and describes the relationship between the applicable independent variable(s) and the damper position(s) required to maintain the required amount of fresh air over a range of operation, as well as the testing method required to determine the values that define the relationship(s).

SZU and MZU Damper Position vs. Fan Speed Relationship

For SZU's and MZU's, the independent variable used to control damper position(s) is Supply Fan Speed (Units in %). The following figure depicts a hypothetical relationship between OA Damper position, RA Damper position, and Fan Speed. Note that this is an example only and depicts a system with a modulating OA Damper and modulating RA Damper, however, the system may only have one or the other component, in which case only that component of the hypothetical example applies. Endpoints and slope for defining the linear relationship for each component will be determine by testing and may vary from system to system.

In the example below, the Fan Speed Ventilation Min corresponds with the Fan Speed required to achieve Design OA CFM with the OA Damper fully open and the RA Damper at its minimum position. The Fan Speed Min is the minimum speed that the fan would normally be allowed to run in the absence of the need to achieve Design OA CFM. In some cases, these two values may be equal (Fan Speed Ventilation Min = Fan Speed Min), as determined during testing. In systems with no modulating RA Damper, this point would correspond with the OA Damper Position Max value rather than the RA Damper Position Min value.

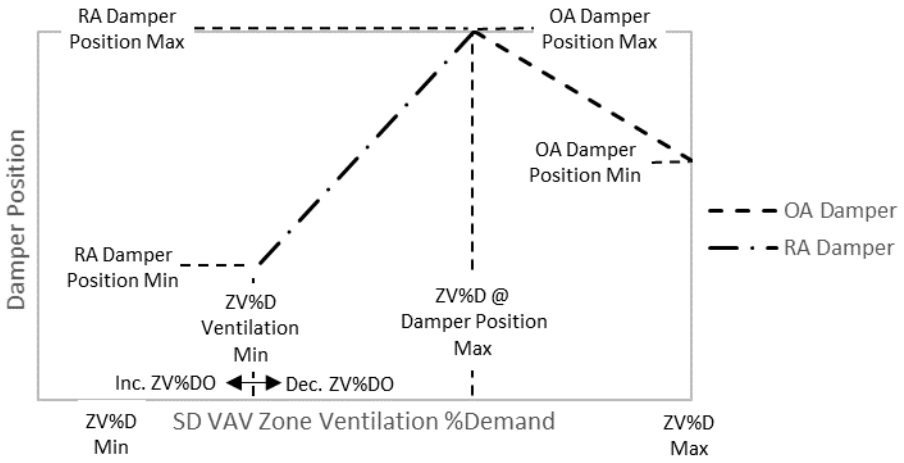


SD VAV Damper Position vs. Zone Ventilation %Demand (ZV%D) Relationship

For SD VAV's, the independent variable used to control damper position(s) is Zone Ventilation %Demand (ZV%D, units in %). The following figure depicts a hypothetical relationship between OA Damper position, RA Damper position, and Zone Ventilation %Demand (ZV%D). Note that this is an example only and depicts a system with a modulating OA Damper and modulating RA Damper, however, the system may only have one or the other component, in which case only that component of the hypothetical example applies. Endpoints and slope for defining the linear relationship for each component will be determine by testing and may vary from system to system.

In the example below, the ZV%D Override Min corresponds with the Zone Ventilation %Demand required to achieve Design OA CFM with the OA Damper fully open and the RA Damper at its minimum position. The ZV%D Min is the normal minimum ZV%D, as defined by the sum of the terminal box CFM SP Min's divided by the AHU design supply CFM, in the absence of the need to achieve Design OA CFM. In some cases, these two values may be equal (ZV%D Ventilation Min = ZV%D Min), as determined during testing. In systems with no modulating RA Damper, this point would correspond with the OA Damper Position Max value rather than the RA Damper Position Min value.

The ZV%D Override is applied equally to all terminal boxes (this is done for simplicity) by multiplying the ZV%D Override generated at the SD VAV AHU by each terminal box CFM SP Max on a box-by-box basis, and therefore the impact on CFM SP Min at each box will vary. In other words, the result may be lower or higher than the actual CFM SP Min when applied to any give box for any given ZV%D Override value. Furthermore, when the ZV%D Override is increased due to the need to provide OA Design CFM, it will eventually result in a higher CFM SP than needed for temperature control to many, if not all, of the terminal boxes served by the SD VAV AHU. This, in turn, will result in a higher likelihood of overcooling spaces. Therefore, to leverage system diversity to minimize the impact of overriding the minimum CFM to many or all the terminal boxes, the ZV%D Override is optimized by a trim-and-respond type algorithm, as described in the related Detailed Sequence section. In other words, the ZV%D Override will be increased as the actual ZV%D drops below ZV%D Ventilation Min and decreased as ZV%D rises above the ZV%D Ventilation Min, with an appropriate dead-band in between, as described in the related Detailed Sequence section.



Testing Procedure to Determine Damper Position vs. Fan Speed (SZU, MZU) and ZV%D (SDVAV)

Step	SZU, MZU	SD VAV, DD VAV
Find the Min OA Damper Position		
1	Set AHU Supply Fan Speed = 100% Set RA Damper = 100% (if equipped) Set OA Damper = 0%	Set AHU Supply Fan Speed to automatic, maintain Duct Static Pressure SP Set Duct Static Pressure SP = Max Duct Static Pressure SP Set RA Damper = 100% (if equipped) Set OA Damper = 0% Set all terminal boxes to **Design Max CFM SP**
2	Gradually open the OA Damper until **Design OA CFM** is achieved or the OA Damper is fully open.	Gradually open the OA Damper until Design OA CFM is achieved or the OA Damper is fully open.
3a	If **Design OA CFM** is achieved in Step 2 above then set the **Min OA Damper Position** equal to the position at which **Design OA CFM** is achieved and proceed to "Find the Max OA Damper Position" test.	If Design OA CFM is achieved in Step 2 above then set the **Min OA Damper Position** equal to the position at which **Design OA CFM** is achieved and proceed to "Find the Max OA Damper Position" test.
3b	If **Design OA CFM** is not achieved in Step 2 above then set the **Min OA Damper Position** = 100% and proceed to "Find the Max RA Damper Position", if the unit has no RA Damper then notify the Owner, EOR, and CxA that **Design OA CFM** was not achieved and end the test.	If **Design OA CFM** is not achieved in Step 2 above then set the **Min OA Damper Position** = 100% and proceed to "Find the Max RA Damper Position", if the unit has no RA Damper then notify the Owner, EOR, and CxA that **Design OA CFM** was not achieved and end the test.
Find the Max RA Damper Position		
0	This test is only to be performed if **Design OA CFM** was not achieved above, in the "Find the Min OA Damper Position" test, otherwise proceed to "Find the Max OA Damper Position" test.	This test is only to be performed if **Design OA CFM** was not achieved in the "Find the Min OA Damper Position" test, otherwise proceed to "Find the Max OA Damper Position" test.

1	Set AHU Supply Fan Speed = 100% Set RA Damper = 100% (if equipped) Set OA Damper = 100%	Set AHU Supply Fan Speed to automatic, maintain Duct Static Pressure SP Set Duct Static Pressure SP = Max Duct Static Pressure SP Set RA Damper = 100% (if equipped) Set OA Damper = 100% Set all terminal boxes to **Design Max CFM SP**
2	Gradually close the RA Damper until **Design OA CFM** is achieved or the RA Damper is fully closed. Record the RA Damper position at which Design OA CFM is achieved and proceed to "Find the Min RA Damper Position" test.	Gradually close the RA Damper until **Design OA CFM** is achieved or the RA Damper is fully closed. Record the RA Damper position at which Design OA CFM is achieved and proceed to "Find the Min RA Damper Position" test.
Find the Max OA Damper Position		
0	If **Min OA Damper Position** < 100% then proceed to Step 1 below. If the **Min OA Damper Position** = 100% open, as determined under "Find the Min OA Damper Position", then set **Max OA Damper Position** = 100% open and skip the remaining steps in this section. If the AHU includes a modulating RA Damper then go to "Find Min RA Damper Position", otherwise notify the Owner, EOR, and CxA that **Design OA CFM** was not achieved and end the testing.	If **Min OA Damper Position** < 100% then proceed to Step 1 below. If the **Min OA Damper Position** = 100% open, as determined under "Find the Min OA Damper Position", then set **Max OA Damper Position** = 100% open and skip the remaining steps in this section. If the AHU includes a modulating RA Damper then go to "Find Min RA Damper Position", otherwise notify the Owner, EOR, and CxA that **Design OA CFM** was not achieved and end the testing.
1	Set AHU Supply Fan Speed = Fan Speed Min (50% for SZU's, 75% for MZU's) Set RA Damper = 100% (if equipped) Set OA Damper = **Min OA Damper Position** determined under "Find the Min OA Damper Position"	Set AHU Supply Fan Speed to automatic (maintain Duct Static Pressure SP) Set Duct Static Pressure SP = Min Duct Static Pressure SP (typically 0.5 inwc) Set RA Damper = 100% (if equipped) Set OA Damper = **Min OA Damper Position** determined under "Find the Min OA Damper Position" Set all terminal boxes to **Design Min CFM SP** Set the **ZV%DO** = **ZV%DO Min**
2	Slowly open the OA Damper until **Design OA CFM** is achieved or the OA Damper is fully open.	Slowly open the OA Damper until **Design OA CFM** is achieved or the OA Damper is fully open.
3a	If **Design OA CFM** is achieved in Step 2 above, then set the **Max OA Damper Position** = position at which **Design OA CFM** is achieved and set **Fan Speed @ Damper Position Max** = **Fan Speed Min**, and skip the remaining steps in this section and go to "Fin Min RA Damper Position" if equipped or end the test if not equipped with RA Damper.	If **Design OA CFM** is achieved in Step 2 above, then set the **Max OA Damper Position** = position at which **Design OA CFM** is achieved, and set the **ZV%D @ OA Damper Position Max** (%) = **ZV%D Min** (%), and skip the remaining steps in this section and go to "Find Min RA Damper Position" if equipped or end the test if not equipped with RA Damper.
3b	If **Design OA CFM** is not achieved in Step 2 above, then set the **OA Damper Position Max** = 100% and continue to Step 4	If **Design OA CFM** is not achieved in Step 2 above, then set the **OA Damper Position Max** = 100% and continue to Step 4

4	Slowly increase the **Supply Fan speed** until **Design OA CFM** is achieved or **Supply Fan Speed** = 100%	Slowly increase the **ZV%DO** until **Design OA CFM** is achieved or **ZV%DO** = 100%.
5a	If **Design OA CFM** is achieved in Step 4 above, then set the **Fan Speed @ Damper Position Max** = **Supply Fan Speed** at which **Design OA CFM** was achieved in Step 4.	If **Design OA CFM** is achieved in Step 4 above, then set the **ZV%D @ OA Damper Position Max** = **ZV%D** at which **Design OA CFM** was achieved in Step 4.
5b	If **Design OA CFM** is not achieved in Step 4 above, then set the **Fan Speed @ Damper Position Max** = 100%	If **Design OA CFM** is not achieved in Step 4 above, then set the **ZV%D @ Damper Position Max** = 100%
6	If the unit has a RA Damper then skip the remaining steps in this section and proceed to "Find the Min RA Damper Position" test, else proceed to Step 7 below.	If the unit has a RA Damper then skip the remaining steps in this section and proceed to "Find the Min RA Damper Position" test, else proceed to Step 7 below.
7a	If Design OA CFM was achieved in Step 4 above, then set Fan Speed Ventilation Min = Fan Speed at which Design OA CFM was achieved	If Design OA CFM was achieved in Step 4 above, then set ZV%D Ventilation Min = ZV%D at which Design OA CFM was achieved.
7b	If **Design OA CFM** was not achieved in Step 4 above, notify the Owner, EOR, and CxA that Design OA CFM was not achieved. End Test.	If **Design OA CFM** was not achieved in Step 4 above, then notify the Owner, EOR, and CxA that Design OA CFM was not achieved. End Test.
Find the Min RA Damper Position		
0	If **Design OA CFM** was achieved with AHU Supply Fan Speed = the minimum speed that the fan would ever be operated at (typically 33% or 20Hz) and RA Damper Position = 100% open, then no modulation of the RA Damper is necessary, set the **RA Damper Position Min** = 100% (adj) and skip the remaining steps in this section.	If **Design OA CFM** was achieved with all terminal boxes at **Design Min CFM SP,** and **ZV%DO** did not need to be increased from **ZV%DO Min** to achieve **Design OA CFM**, then no modulation of the RA Damper is necessary, set the **RA Damper Position Min** = 100% (adj) and skip the remaining steps in this section.
1	Set AHU Supply Fan Speed = Fan Speed Min (50% for SZU's, 75% for MZU's) Set RA Damper = 100% Set OA Damper = 100%	Set AHU Supply Fan Speed to automatic (maintain Duct Static Pressure SP) Set Duct Static Pressure SP = Duct Static Pressure SP Min Set RA Damper = 100% Set OA Damper = 100% Set all terminal boxes to **Design Min CFM SP** Set the **ZV%DO** = 0%
2	Slowly close the RA Damper until **Design OA CFM** is achieved or the RA Damper is closed. At the resulting position, increase the fan speed to 100% and measure the TSP and Supply Air CFM. If the fan is in an unstable region or Supply Air CFM is less than minimum (50% of design for SZU, 75% of design for MZU), then open the RA damper until minimum is achieved or fan is in a stable region of operation. *Note: If RA Damper position*	Slowly close the RA Damper until **Design OA CFM** is achieved or **RA Damper Position** (%) = **ZV%D Min** (%)

	*had to be increased to avoid unstable operation or obtain minimum airflow then **Design OA CFM** was not achieved.*	
3a	If **Design OA CFM** is achieved in Step 2 above then set the **RA Damper Position Min** = the RA damper position at which **Design OA CFM** is achieved, and set the **Fan Speed Ventilation Min** = **Supply Fan Speed Minimum**, and end the test.	If **Design OA CFM** is achieved in Step 2 above then set the **RA Damper Position Min** = the RA damper position at which **Design OA CFM** is achieved, and **ZV%D Ventilation Min** = **ZV%D Min**, and end the test.
3b	If **Design OA CFM** is not achieved in Step 2 above then set **RA Damper Position Min** = the final **RA Damper Position** achieved in Step 2 (for stable operation and minimum supply air flow), and continue to Step 4.	If **Design OA CFM** is not achieved in Step 2 above then set the **RA Damper Position Min** = the final **RA Damper Position** achieved in Step 2, and continue to Step 4.
4	Slowly increase the **AHU Supply Fan Speed** until **Design OA CFM** is achieved or the **AHU Supply Fan Speed** = 100%	Slowly increase the **ZV%DO** until **Design OA CFM** is achieved or **ZV%DO** = 100%
5a	If **Design OA CFM** is achieved in Step 4 above then set the **Fan Speed Ventilation Min (%)** = **AHU Supply Fan Speed** (%) at which **Design OA CFM** was achieved in Step 4.	If **Design OA CFM** is achieved in Step 4 above then set the **ZV%D Ventilation Min** = the **ZV%D** at which **Design OA CFM** is achieved in Step 4.
5b	If **Design OA CFM** is not achieved in Step 4 above then set the **Fan Speed Ventilation Min** = 100% and notify the Owner, EOR, and CxA that **Deisgn OA CFM** was not achieved.	If **Design OA CFM** is not achieved in Step 4 above then set the **ZV%D Ventilation Min** = 100% and notify the Owner, EOR, and CxA that **Design OA CFM** was not achieved.

Detailed Sequence for AHU Outside Air, Return Air, Relief Air Damper/Fan

Return Air Damper	**Relief Air Damper**	**Relief Air Fan**	**OA Supply Fan**	**OA Damper**	**AHU OUTSIDE AIR, RETURN AIR, AND RELIEF AIR DAMPER/FAN SEQUENCE (Covers listed damper control associated with applicable Group 1 AHU's)** *Note: The applicable detailed sequences in this section should be included in sequence page for the associated Group 1 AHU and shown on the associated Group 1 AHU graphic.*	**Revision History**
				X	**Enable/Disable OA Damper Control**	0.9
				X	Enable OA Damper Control if ALL are True, otherwise Close the damper	0

				X	General OA Schedule[25] = ON (*Remove this line if AHU is 100% OA and providing comfort heating and cooling directly to the space*)	0
				X	AHU Supply Fan Status = ON	0
				X	Low Limit Switch (Freeze Stat) = OFF	0
				X	Associated OAHU Low Limit Switch (Freeze Stat) = OFF	0
				X	Associated OAHU Freeze Prevention = OFF	0
				X	*For units with 2-position Min OA Damper & Max OA Damper, the following conditions apply in addition to those above for the Max OA Damper only:*	0
				X	*For Kitchen AHU*: At least one Kitchen Hood is ON as verified by Hood EF Status	0
			[X]	**X**	**2-Position OA Damper [On/Off Supply Fan] (no Process Variable control)**	0.9 [1.0]
			[X]	X	If OA Damper [OA SF] is Enabled, then Open the OA Damper [Start the OA SF]	0.4 [1.0]
			[X]	X	If OA Damper [OA SF] is Disabled, then Close the OA Damper [Stop the OA SF]	0.9 [1.0]
			[X]	**X**	**2-Position OA Damper [On/Off Supply Fan] (with Process Variable control)**	0.9
			[X]		*[If application is an OA SF then replace Damper Open/Close with OA SF On/Off in the sequence below]*	*[1.0]*
				X	*For units with Return Air / Space CO_2 control then do the following*	*0.9*
				X	If Controlling CO_2 > 800ppm (adj) the Open the OA Damper	0.4
				X	If Controlling CO_2 < 700ppm (adj) then Close the OA Damper	0.4
				X	*For units with Mixed Air CO_2 control then do the following*	*0.9*
				X	Min MA CO_2 Setpoint = TBD* (adj) *Determined using "CO2 Concentration Setpoint Determination Procedure" in this specification.	0.9
				X	Max MA CO_2 Setpoint = TBD* (adj) *Determined using "CO2 Concentration Setpoint Determination Procedure" in this specification.	0.9
				X	Set MA CO_2 SP according to the following linear reset: SZU/MZU Fan Speed* — MA CO_2 SP 100% — Max MA CO_2 SP 80% — Min MA CO_2 SP *Speed used in "CO_2 Concentration Setpoint Determination Procedure for SZU and MZU AHU's"	0.9
				X	If Controlling MA CO_2 > MA CO_2 SP then Open the OA Damper	0.9
				X	If Controlling MA CO_2 < MA CO_2 – 200 ppm (adj) then Close the OA Damper Note: If OA Damper is Closed due to this condition, then display "DCV Active" on the AHU graphic	0.9
				X	*For units without CO_2 control do the following*	*0.4*
				X	Open the OA Damper	0.4
X					**2-Position Return Air Damper**	0
X					RA Damper Position Min = TBD* (adj)	0
X					RA Damper Position Max = 100% (adj)	0

[25] If "OA Shutdown Schedule" is used in lieu of "General OA Schedule" then the logic must be reversed as described in the Definitions section under "General OA Schedule" and "OA Shutdown Schedule"

X					Resting state (disabled) for RA Damper is 100% Open	0
X					Enable RA Damper Control if associated OA Damper control is Enabled and Open, otherwise RA Damper is at rest (fully open) *Note: for units with Min OA Damper and Max OA Damper, the RA Damper is associated with the Max OA Damper*	0.9
X					If the RA Damper is Enabled and OA Damper is Open, RA Damper Position = RA Damper Position Min	0.9
				X	**Modulating OA Damper (no Process Variable control)**	0
				X	Min OA Damper Position = TBD* (adj)	0
				X	Max OA Damper Position = TBD* (adj)	0
				X	For SZU's and MZU's Fan Speed @ Max Damper Position = TBD* (adj)	0
				X	For SDVAV's ZV%D @ Max Damper Position = TBD* (adj)	0
				X	Enable OA Damper Control if ALL are True, otherwise Close the damper	0
				X	General OA Schedule[26] = ON	0
				X	AHU Supply Fan Status = ON	0
				X	Low Limit Switch (Freeze Stat) = OFF	0
				X	Associated OAHU Low Limit Switch (Freeze Stat) = OFF	0
				X	Associated OAHU Freeze Prevention = OFF	0
				X	If OA Damper is Enabled, then do the following:	0
				X	Adjust the OA Damper based on the following applicable OA Damper Position Reset Schedule:	0
				X	*For SZU's and MZU's* As AHU Supply Fan Speed goes from Fan Speed Max to Fan Speed @ Damper Position Max (TBD*, adj), adjust the OA Damper position linearly from Damper Position Min to Damper Position Max.	0
				X	*For SDVAV's* As ZV%D goes from 100% (adj) to ZV%D @ Damper Position Max (TBD*, adj), adjust the OA Damper linearly from Min OA Damper Position to Max OA Damper Position.	0
				X	**The damper positions (OA Max & Min) and associated independent variables (Fan Speed %, ZV%D) used shall be determined at startup using the method described in this section under Testing Procedure to Determine Damper Position vs. Fan Speed (SZU, MZU) and ZV%D (SDVAV).*	0
X					**Modulating Return Air Damper (no Process Variable control)**	0
X					RA Damper Position Min = TBD* (adj)	0
X					RA Damper Position Max = 100% (adj)	0
X					Resting state (disabled) for RA Damper is 100% Open	0
X					Enable RA Damper Control if associated OA Damper control is Enabled, otherwise RA Damper is at rest (*Note: For units with Min OA Damper and Max OA Damper, the RA Damper is associated with the Max OA Damper*)	0
X					Adjust the RA Damper Position between Min and Max using the following applicable RA Damper Position Reset Schedule:	0

[26] If "OA Shutdown Schedule" is used in lieu of "General OA Schedule" then the logic must be reversed as described in the Definitions section under "General OA Schedule" and "OA Shutdown Schedule"

X					For SZU's and MZU's: As AHU Supply Fan Speed goes from Fan Speed @ Damper Position Max (Adj, TBD*) to Fan Speed Ventilation Min (Adj, TBD*), adjust the RA Damper position linearly from 100% Open to RA Damper Position Min.	0
X					For SDVAV's: As ZV%D goes from ZV%D @ Damper Position Max (Adj, TBD*) to ZV%D Ventilation Min (Adj, TBD*), adjust the RA Damper linearly from 100% Open to RA Damper Position Min.	0
X					**The damper positions (RA Max & Min) and associated independent variables (Fan Speed %, ZV%D) used shall be determined at startup using the method described in this section under Testing Procedure to Determine Damper Position vs. Fan Speed (SZU, MZU) and ZV%D (SDVAV).*	0
					Note: All spring-return RA Dampers shall fail in the Open position	0
				X	**Modulating OA Damper (with Process Variable control)**	0
				X	*Note: the following logic is written so that it may be applied to OA Damper Position directly or to OA CFM Setpoint if an air flow monitoring station (AFMS) is present, as indicated by [brackets]. Where AFMS is present, use the [bracketed] variable in the logic below.*	0
				X	Min OA Damper Position = 15% Open (adj) [Min OA CFM SP = 15% of Design SA CFM (adj)] *Note: as required to maintain Min OA Airflow for ventilation or to maintain building pressure or to satisfy constant flow requirements of OAHU serving the AHU, as indicated by Engineer.*	0
				X	Max OA Damper Position = 100% Open (adj)	0
				X	*For RA/Space CO_2 Control*	*0.9*
				X	Hi CO_2 ppm Setpoint = 1000 ppm (adj)	0
				X	Lo CO_2 ppm Setpoint = Hi CO_2 SP - 200 ppm (adj)	0.9
				X	*For Mixed Air CO_2 Control*	*0.9*
				X	Min MA CO_2 Setpoint = TBD* (adj) **Determined using "CO2 Concentration Setpoint Determination Procedure" in this specification.*	0.9
				X	Max MA CO_2 Setpoint = TBD* (adj) **Determined using "CO2 Concentration Setpoint Determination Procedure" in this specification.*	0.9
				X	Set MA CO_2 SP according to the following linear reset: SZU/MZU Fan Speed* MA CO_2 SP 100% Max MA CO_2 SP 80% Min MA CO_2 SP **Speed used in "CO_2 Concentration Setpoint Determination Procedure for SZU and MZU AHU's"*	0.9
				X	Hi CO_2 ppm Setpoint = MA CO_2 SP	0.9
				X	Lo CO_2 ppm Setpoint = Hi CO_2 SP – 200 ppm (adj)	0.9
				X	Enable OA Damper Control if ALL are True, otherwise Close the damper	0

				X	General OA Schedule[27] = ON	0
				X	AHU Fan Status = ON	0
				X	*Note: For OA Damper (like VAV box or in-line zone damper with or without integrated flow cross) fed from constant volume OAHU (like DX OAHU) supplying OA to multiple units, Enable the OA Damper Control whenever the OAHU is enabled regardless of AHU Fan Status or General OA Schedule[28].*	0
				X	If OA Damper is Enabled, then do the following	0
				X	Drive the OA Damper Position [OA CFM Setpoint] to Min OA Damper Position [Min OA CFM Setpoint]	0
				X	After 5 minutes (adj), allow the OA Damper Position [OA CFM Setpoint] to be adjusted in accordance with the following, and as applicable based on available sensors. *Note: If required process variable sensor is not provided then the logic is not applicable and may be omitted from the programming.*	0
				X	If CO_2 Sensor is present, then adjust DCV OA Damper Position [DCV OA CFM Setpoint] between Min OA Damper Position [Min OA CFM Setpoint] and Max OA Damper Position [Max OA CFM Setpoint] every 5 minutes (adj) as follows	0
				X	While CO_2 ppm > Hi CO_2 ppm then increase DCV OA Damper Position [DCV OA CFM Setpoint] by 7% (adj) of Max OA Damper Position [Max OA CFM Setpoint]	0
				X	While CO_2 ppm < Lo CO_2 ppm then decrease DCV OA Damper Position [DCV OA CFM Setpoint] by 5% (adj) of Max OA Damper Position [Max OA CFM Setpoint]	0
				X	If Economizer = ON, then modulate Economizer OA Damper Position [Economizer OA CFM Setpoint] between Min OA Damper Position [Min OA CFM Setpoint] and Max OA Damper Position [Max OA CFM Setpoint] to maintain Mixed Air Temperature at CHW Coil DAT SP - 1°F(adj) using proportional-integral control. *Note: If unit does not have a Mixed Air Temperature sensor then use the CHW Coil DAT instead.*	0
				X	OA Damper Position [OA CFM Setpoint] = Maximum of the following values	0
				X	Min OA Damper Position [Min OA CFM Setpoint]	0
				X	DCV OA Damper Position [DCV OA CFM Setpoint]	0
				X	Economizer OA Damper Position [Economizer OA CFM Setpoint]	0
				X	If the AHU is served with OA from direct ducted OA intake with that depends on the AHU Fan to induce outside air flow through the OA duct and Low Limit Switch (Freeze Stat) is present in the OA stream, then do the following: Close the OA Damper and issue Medium Priority Alarm if Low Limit Switch (Freeze Stat) is tripped Return to Normal when Low Limit Switch is reset	0
				X	If a Low Limit Switch (Freeze Stat) is installed anywhere in the main air stream, then do the following:	0

[27] If "OA Shutdown Schedule" is used in lieu of "General OA Schedule" then the logic must be reversed as described in the Definitions section under "General OA Schedule" and "OA Shutdown Schedule"
[28] If "OA Shutdown Schedule" is used in lieu of "General OA Schedule" then the logic must be reversed as described in the Definitions section under "General OA Schedule" and "OA Shutdown Schedule"

					Close the OA Damper and issue Medium Priority Alarm if Low Limit Switch (Freeze Stat) is tripped, manual reset required. Return to Normal when Low Limit Switch is reset	
X					**Modulating Return Air Damper (with Process Variable control)**	0
X					Min RA Damper Position = 50% Open (adj) Note*: Adjusted during startup as necessary to achieve required process variable control or design OA with OA Damper fully open.*	0
X					Max RA Damper Position = 100% Open (adj)	0
X					If Modulating RA Damper is present, then control the RA Damper(s) as follows:	0
X					Adjust the RA Damper Position between Min and Max in accordance with the following, every 1 minutes (adj)	0
X					While OA Damper Position is > 99% (adj) decrease the RA damper position by 3% (adj.)	0
X					While the OA damper position < 90% (adj) increase the RA damper position by 1% (adj.)	0
	X				**Relief Air Damper Control**	0
	X				The Relief Air Damper shall be controlled and track with the associated AHU Outside Air Damper as follows	0
	X				Open and Close the Relief Air Damper in unison with the AHU Outside Air Damper	0
	X				If equipped with modulating damper actuator, do the following	0
	X				Relief Air Damper Position = Position Offset Multiplier * Outside Air Damper Position	0
	X				Position Offset Multiplier = 1.0 (adj between 0 and 1)	0
		X			**Relief Air Fan Control**	**1.0**
		X			The Relief Air Fan shall be controlled and track with the associated AHU Outside Air Damper or OA Supply Fan as follows	1.0
		X			Start and Stop the Relief Air Damper in unison with the AHU Outside Air Damper Open and Close positions	1.0
		X			If equipped with VFD, do the following	1.0
		X			Relief Air Fan Speed = Speed Offset Multiplier * Outside Air Damper Position	1.0
		X			Position Offset Multiplier = 1.0 (adj between 0 and 1)	1.0
					END OF DETAILED SEQUENCE	

2.2 – EXHAUST AIR SYSTEMS

2.2.1 – GENERAL EXHAUST FANS

General Exhaust fans such as restroom exhaust fans are generally controlled by the BMCS unless otherwise called for in the job-specific Design Documents. All exhaust fans, whether controlled by the BMCS or not, shall be monitored by the BAS using positive status feedback current transducer to detect the difference between fan off and belt off condition, RIB-type relay status is not acceptable. All exhaust fans shall be associated with a Fresh Air System and organized/presented as such in the system GUI. For any EF controlled by the BAS, enable the EF when the associated Fresh Air System is Enabled and proven ON by OA fan status input. Provide notification via Low Priority Alarm if any Exhaust Fan is running and the associated Fresh Air System is not running. Provide

notification via Low Priority Alarm if any BAS controlled EF is commanded ON but not running, or any EF status is ON and the command is OFF. The dampers shall be interlocked with associated fan operation via hardwired end-switch interlock with Fan enable circuit.

2.2.2 – KILN ROOM EXHAUST AIR SYSTEM

General

Kiln exhaust fan shall be furnished with a line voltage thermostat wired in parallel with a 6 hour timer without a hold feature.

Detailed Sequence

Normally, the manual 6hr timer shall be activated by the user whenever the kiln is in operation.

The line voltage thermostat shall be furnished with cooling control and shall act as a back-up to the manual 6hr timer. Set the line voltage thermostat to turn on the Kiln EF whenever the temperature rises above the setpoint, 80F (user adjustable).

2.2.3 – LABORATORY CLASSROOM, PREP ROOM, CLASSROOM PURGE, AND FUME HOOD SYSTEMS

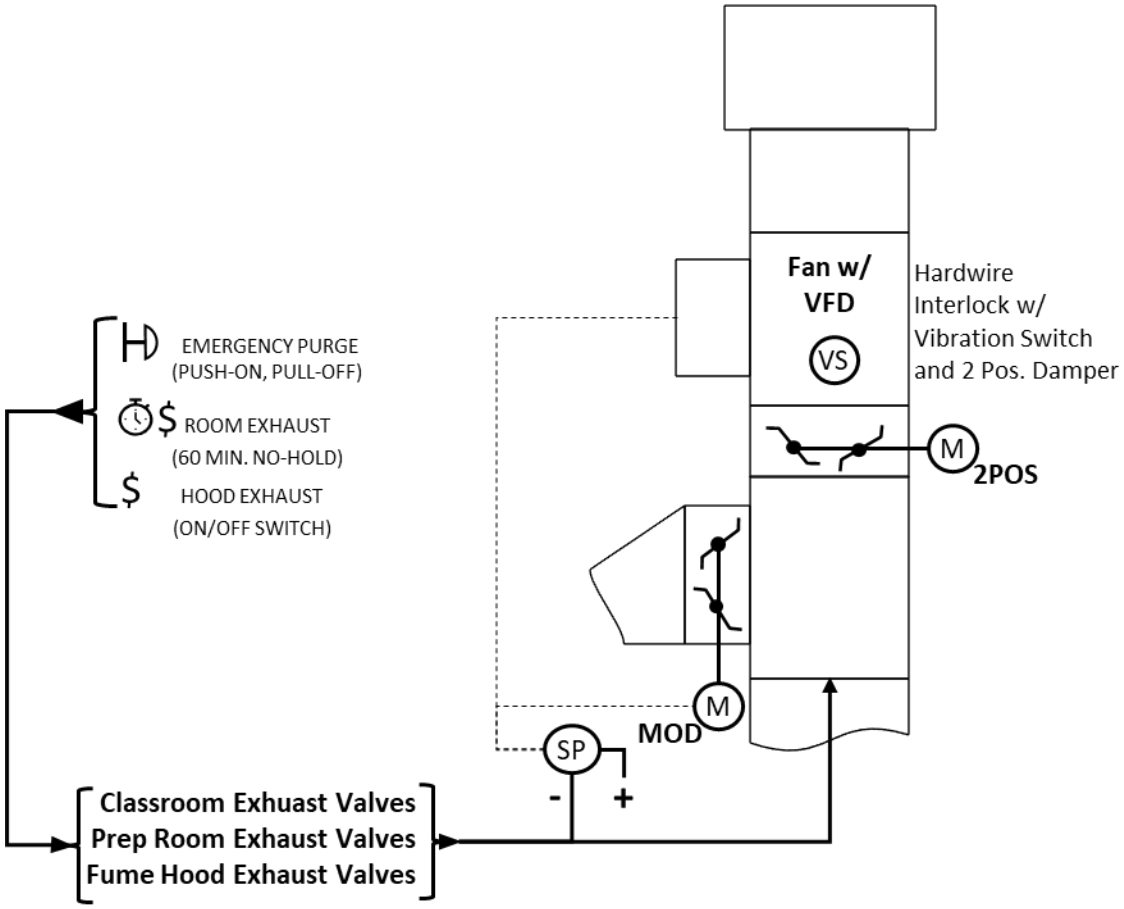
General

Laboratory classrooms usually have fume hood exhaust and room exhaust systems. This section applies to all laboratory classroom and fume hood exhaust systems. All EF's shall be monitored by the BAS using positive feedback, RIB type control relay status feedback is not acceptable.

A variable volume exhaust system generally consists of a VFD driven Exhaust Fan that draws air from classrooms, prep rooms, and fume hoods via exhaust valves. Exhaust valves generally will be like a VAV box with a modulating damper and air flow measurement device to maintain air flow setpoint. The system will generally include a modulating relief damper that works in tandem with the fan VFD speed control to maintain static pressure setpoint (negative) in the duct. A 2-position exhaust damper opens and closes with system operation, like a typical exhaust fan damper, the fan is hardwire-interlocked with open end-switch of the 2-position damper.

A constant volume exhaust system generally consists of a dedicated Exhaust Fan that draws air directly from a classroom, prep room, or fume hood. A 2-position exhaust damper opens and closes with Exhaust Fan operation, like a typical exhaust fan damper, the fan is hardwire-interlocked with open end-switch of the 2-position damper.

The schematic diagram and detailed sequence that follows may be applied to the variable volume system described above or it may be applied to the simpler constant volume system described above by eliminating components and parts that do not apply.



Detailed Sequence

Fume Hood Exhaust	Prep Room Exhaust	Classroom Exhaust	2-Pos. Exhaust Damper	Modulating Relief	VFD	Default	**Laboratory Classroom, Prep Room, Purge, and Fume Hood System**	**Revision History**
						X	**Enable/Disable**	0
						X	Enable the system when ANY of the following are True	0
						X	The associated AHU serving the same area is Occupied	0
						X	Any Emergency Purge Switch is ON	0
						X	Any room exhaust Timer Switch is ON	0
						X	Disable the system when ALL of the above conditions are False for 5 minutes (adj)	0
						X	**Exhaust Fan Start/Stop**	0
						X	Start the Fan when the system is Enabled and ANY of the following are True	0
						X	Any associated room exhaust Timer Switch is ON	0

						X	Any associated Emergency Purge Switch is ON	0
						X	Any associated Fume Hood Switch is ON	0
			X				Associated 2-position Exhaust Fan Damper is Open (hardwire interlocked)	0
						X	Stop the Fan when the system is Disabled	0
					X		**Exhaust Fan Speed**	0
					X		*Note: Use this section only if the exhaust fan speed may be varied more than 15% while maintaining minimum required nozzle velocity and maintain duct static setpoint. Otherwise, set fan speed to constant speed and use Modulating Relief Damper with Constant Speed Fan to maintain duct static pressure setpoint.*	0
					X		Design Nozzle Velocity (per manuf. data) = 3500 fpm (adj)	0
					X		Design CFM (per manuf. data) = per design documents CFM (adj)	0
					X		Minimum Nozzle Velocity (per design) = 2000 fpm (adj)	0
					X		Minimum CFM = Design CFM * Minimum Nozzle Velocity / Design Nozzle Velocity	0
					X		Min Fan Speed = 57% (adj) *Note: Set Min Fan Speed by closing all Exhaust Valves and opening Relief Damper 100%, measure flow rate through relief damper using traverse or other flow measurement method, set minimum fan speed equal to fan speed required to achieve flow rate corresponding with minimum nozzle velocity (per manufacturers data)*	0
					X		Max Fan Speed = 100% (adj)	0
					X		Min Duct Static SP = 0.5 inwc (adj)	0
					X		Max Duct Static SP = 1.0 inwc (adj)	0
					X		Max Exhaust Valve Position = Maximum of all associated Exhaust Valve Positions	0
					X		Avg. Exhaust Valve Position = Average of all associated Exhaust Valve Positions	0
					X		N = 3.0 (adj)	0
					X		Exhaust Valve Demand = Sum of Flow Setpoints of all associated Exhaust Valves	0
					X		Exhaust Valve Flow = Sum of measured Flow from all associated Exhaust Valves	0
					X		Controlling Exhaust Valve Position = (Avg. + N*Max) / (N + 1)	0
					X		If system is Disabled, then Fan Speed = Min Fan Speed	0
					X		If system is Enabled, then do the following:	0
					X		Modulate the Fan Speed between Min and Max with PI Loop control to maintain Duct Static Pressure at Duct Static SP	0
					X		Adjust Duct Static SP between Min and Max at 1.0 Minute (adj) intervals:	0
					X		If Controlling Damper Position > 80% (adj) then increase Static SP by 0.2 inwc (adj)	0

					X		If Controlling Damper Position < 60% (adj) then decrease Static SP by 0.1 inwc (adj)	0
				X	**X**		**Modulating Relief Damper with Variable Speed Fan**	0
				X	X		Min Damper Position = 0% (adj)	0
				X	X		Max Damper Position = 100% (adj)	0
				X	X		If Exhaust Fan is OFF, then Relief Damper = Min Damper Position	0
				X	X		If Exhaust Fan is ON, then adjust the Relief Damper position between Min and Max as follows at 1 minute (adj) intervals:	0
				X	X		While Fan Speed < Min Fan Speed + 5% (adj), increase the Relief Damper position by 7% (adj)	0
				X	X		While Fan Speed > Min Fan Speed + 10% (adj), decrease the Relief Damper position by 3% (adj)	0
				X			**Modulating Relief Damper with Constant Speed Fan**	0
				X			Min Damper Position = 0% (adj)	0
				X			Max Damper Position = 100% (adj)	0
				X			Duct Static SP = -1.0 inwc (adj)	0
				X			If Exhaust Fan is OFF, then Relief Damper = Min Damper Position	0
				X			If Exhaust Fan is ON, then do the following:	0
				X			Modulate the relief damper between Min and Max using PI Loop control to maintain Duct Static Pressure at Duct Stati SP	0
			X				**2-Position Exhaust Damper**	0
			X				Open the Exhaust Damper when the system is Enabled and ANY of the following are True	0
			X				Any associated room Timer Switch = ON	0
			X				Any associated Emergency Purge Switch = ON	0
			X				Any associated Fume Hood Switch= ON	0
			X				Close the Exhaust Damper when the system is Disabled	0
		X					**Classroom Exhaust Valve with Purge**	0
		X					Duct Size = per design schedule (adj)	0
		X					K Factor = per box manufacturer and duct size (adj)	0
		X					Calibration Constant = per TAB (adj)	0
		X					Min Flow SP = *per design schedule* (adj)	0
		X					Intermediate Flow SP = *per design schedule* (adj)	0
		X					Max Flow SP = *per design schedule* (adj)	0
		X					Timer Switch Status = “ON” or “OFF” *Note: Timer Switch is a 60-minute no-hold switch located near the Emergency Purge switch in the classroom accessible by instructors and students and clearly labelled “***ROOM EXHAUST***”.*	0
		X					Emergency Purge Status = “ON” or OFF” *Note: Emergency Purge Switch is a covered push-on twist-off switch located near the Timer Switch in the classroom accessible to instructors and students and clearly labelled “***EMERGENCY PURGE***”.*	0

		X					If system = Enabled and Exhaust Fan = ON then control the Exhaust Valve using PI loop control to maintain Flow SP according to the following:	0
		X					If associated Timer Switch = ON then Exhaust Valve flow setpoint = Intermediate Flow SP	0
		X					If associated Emergency Purge Switch = ON then Exhaust Valve flow setpoint = Max Flow SP	0
		X					If ALL are True then Exhaust Valve flow setpoint = Min Flow SP	0
		X					Associated Timer Switch = OFF	0
		X					Associated Emergency Purge Switch = OFF	0
		X					If system = Disabled and Exhaust Fan = OFF then Exhaust Valve = Closed	0
	X	**X**					**Classroom and Prep Room Exhaust Valve without Purge**	0
	X	X					Min Flow SP = *per design schedule* (adj)	0
	X	X					Max Flow SP = *per design schedule* (adj)	0
	X	X					Timer Switch Status = "ON" or "OFF" *Note: Timer Switch is a 60-minute no-hold switch located in the classroom accessible by instructors and students and clearly labelled "***ROOM EXHAUST***"*	0
	X	X					If system = Enabled and Fan = ON then control the Exhaust Valve using PI loop control to maintain Flow SP according to the following:	0
	X	X					If associated Timer Switch = ON then Exhaust Valve flow setpoint = Max Flow SP	0
	X	X					If associated Timer Switch = OFF then Exhaust Valve flow setpoint = Min Flow SP	0
	X	X					If system = Disabled and Exhaust Fan = OFF then Exhaust Valve = Closed	0
X							**Fume Hood Exhaust Valve**	0
X							Min Flow SP = *per design schedule* (adj)	0
X							Max Flow SP = *per design schedule* (adj)	0
X							Hood Switch Status = "ON" or "OFF" *Note: Hood Switch is a manual switch with "ON" or "OFF" indication located on the Fume Hood accessible by instructors and students. Contractor shall furnish and install signage that states the following:* ***"HOOD EXHAUST - TURN HOOD OFF WHEN NOT IN USE. Hood will only run while the lab exhaust system is enabled during occupied hours. System may be enabled manually after hours by activating the ROOM EXHAUST Timer Switch located in the same room or area, in which case the system will be enabled for the duration of the timer"***	0
X							If system = Enabled and Exhaust Fan = ON then control the Exhaust Valve using PI loop control to maintain Flow SP according to the following:	0

X							If associated Hood Switch = ON then Exhaust Valve flow setpoint = Max Flow SP	0
X							If associated Hood Switch = OFF then Exhaust Valve flow setpoint = Min Flow SP	0
X							If system = Disabled and Exhaust Fan = OFF then Exhaust Valve = Closed	0
							END OF DETAILED SEQUENCE	

2.2.4 – OTHER EXHAUST-ONLY SYSTEMS (DISH WASH, CLASSROOM, ETC.)

All EF's shall be monitored by the BAS using positive feedback, RIB type control relay status feedback is not acceptable. Enable the associated Fresh Air System whenever the EF is ON if the fresh air system serves that device alone, otherwise confirm with engineer and owner prior to interlocking operation.

Dishwasher EF's are interlocked with the Dishwasher.

Classroom EF's are interlocked with a 60-minute no-hold timer switch located in the classroom and accessible by instructors and students.

2.3 – PAIRED FRESH AIR & EXHAUST SYSTEMS

2.3.1 – KITCHEN HOOD & MAKEUP AIR UNIT (MAU)

General

Kitchen Hood(s) shall generally be controlled manually by cooking staff unless otherwise called for in the job-specific Design Documents. The make-up air unit usually on only provides a fraction of air that is exhausted from the hood, the balance must be supplied from another source such as the Kitchen AHU and/or the Cafeteria AHU fresh air intake. See Section 1.1 "Kitchen AHU / Cafeteria AHU and Kitchen EF / SF Operation Interlocks" for instructions regarding operation of the Kitchen AHU and Cafeteria AHU for fresh air makeup to offset the deficit between total kitchen exhaust air and make-up air from interlocked supply fans.

Enable associated Makeup Air Unit when the Exhaust Hood is proven ON by status feedback. All kitchen hood exhaust fans and makeup air units shall be monitored by the BAS.

Kitchen AHU / Cafeteria AHU and Kitchen EF / SF Operation Interlocks

In general, the air exhausted from the Kitchen by cook-top hood exhaust, dishwasher exhaust, etc. is much greater than the fresh air supplied to the kitchen by supply fans interlocked to operate with the kitchen exhaust fans. Therefore, the difference must be made up by other fresh air intake means such as the Kitchen AHU fresh air intake and/or the Cafeteria AHU fresh air intake. For Kitchen OA Damper, the OA Damper(s) shall be 100% open (adj) whenever the Kitchen AHU is Occupied and any Kitchen Exhaust Fan serving a cooking hood is ON, as verified by exhaust fan status and regardless of General OA

Schedule[29] status. In instances where the balance of fresh air requires fresh air from the Cafeteria AHU (in other words, the Kitchen AHU fresh air intake is not enough), the Cafeteria AHU and associated fresh air source shall be interlocked via software to operate whenever the Kitchen AHU is Occupied and any Kitchen Exhaust Fan serving a cooking hood is ON, as verified by exhaust fan status, and regardless of General OA Schedule[30] status. Note: this interlock is intended for normal operation only, it is not intended to account for times when the Kitchen EF's are left on inadvertently, thus the interlock to Kitchen AHU "Occupied".

Detailed Sequence

The sequence of operation includes instructions for components that may not be applicable to every system. However, the sequences are written so that elimination of components does not impact the operation of remaining components. Therefore, components that are not present may be treated as "Not Applicable".

Fan	OA Damper	Precool	Preheat	Default	KITCHEN HOOD MAKEUP AIR UNIT	Revision History
					General	0
				X	*Follow General section under 2.1.1 – Detailed Sequence for OAHU*	0
				X	**Enable/Disable**	0
				X	Enable the unit if the associated kitchen hood EF = ON	0
				X	**Mode Control**	0
				X	*Follow 2.1.1 Detailed Sequence for OAHU Mode Control section, with the following exceptions*	0
		X			Enter Cooling Mode if OAT > 75F (adj)	0
		X			Return to Ventilate Mode if OAT < 70F (adj)	0
			X		Enter Heating Mode if OAT < 60F (adj)	0
			X		Return to Ventilate Mode if OAT > 65F (adj)	0
				X	**EF Fan Control**	0
				X	KEF shall start whenever wall switch is turned on by occupant	0
				X	**MUA Fan Control**	0
				X	*Follow 2.1.1 Detailed Sequence for OAHU Fan Control section*	0
			X		**Preheat Valve Control**	0
				X	*Follow 2.1.1 Detailed Sequence for OAHU Preheat Valve Control section, with exceptions below*	0
			X		Heating DAT SP = 65F (adj)	0
		X			**CHW Valve Control**	0
				X	*Follow 2.1.1 Detailed Sequence for OAHU CHW Valve Control section, with the following exceptions*	0
		X			Cooling DAT SP = 75F (adj)	0
					END OF DETAILED SEQUENCE	

[29] If "OA Shutdown Schedule" is used in lieu of "General OA Schedule" then the logic must be reversed as described in the Definitions section under "General OA Schedule" and "OA Shutdown Schedule"
[30] If "OA Shutdown Schedule" is used in lieu of "General OA Schedule" then the logic must be reversed as described in the Definitions section under "General OA Schedule" and "OA Shutdown Schedule"

2.3.2 – SHOP EXHAUST & MAKEUP AIR UNIT (MAU)

General

Shop exhaust systems shall generally be controlled manually by shop staff unless otherwise called for in the job-specific Design Documents. Where MAU's are furnished and interlocked with the shop exhaust system, the MAU shall provide neutral air, similar to the process performed by a Kitchen Hood MAU.

Enable associated Makeup Air Unit when the shop Exhaust Fan is proven ON by status feedback. All shop hood exhaust fans and makeup air units shall be monitored by the BAS. The MAU portion shall also be controlled by the BAS per the Detailed Sequence below.

Detailed Sequence

Follow the Detailed Sequence for Kitchen Hood MAU in the previous section, where the shop Exhaust Fan is equivalent to the kitchen hood exhaust fan and shop Supply Fan and Preheat Coil is equivalent to the Kitchen Hood MAU.

2.4 – AIR TO AIR HEAT EXCHANGERS USED IN HVAC ENERGY RECOVERY APPLICATIONS

Air-to-air heat exchanger applications in HVAC take many forms and serve many functions. In general, these devices are designed to transfer heat from one air stream to another. This section is intended to cover applications of air-to-air heat exchangers used in energy recovery devices where the heat transfer is between an exhaust air stream and a fresh air stream for the purpose of reducing the cost of heating and/or cooling the fresh air. This section will be expanded as energy recovery devices are encountered and additional sections will cover other types of air-to-air heat exchangers as they are encountered.

Regardless of the type of air-to-air heat exchanger, fan energy is required to move air across both sides of the heat exchanger. The fans used to move the air through the energy recovery device may be integral to equipment packaged with the air-to-air heat exchanger or may be furnished and installed separately as part of an overall system of energy recovery. Since the fans and other devices typically integrated with air-to-air heat exchangers, such as preheat coils and cooling coils, are typically used anyway for fresh air supply and exhaust, the sequence of operation for the fans and other components is provided elsewhere in this document, depending on the installation. This section only provides the sequence of operation for the energy recovery portion of the equipment and/or system.

In general, while both the exhaust air stream and outside air stream dampers are open and applicable fans are on:

- The BMCS shall monitor differential pressure switch across the outside air and exhaust air elements of the ERU and provide notification via Low Priority Alarm when the unit requires cleaning.
- The BMCS shall monitor effectiveness of the ERU using one of the equations below and provide notification via Low Priority Alarm when the effectiveness falls below 50% (adj) while the OAT < 50°F (adj) or OAT > 90°F (adj)

  Total Heat Recovery Effectiveness = $(h_{o1} – h_{o2}) / (h_{o1} – h_{e1})$

  where:

h_{o1} = enthalpy of outside air entering the ERU

h_{o2} = enthalpy of outside air leaving the ERU

h_{e1} = enthalpy of exhaust air entering the ERU

Sensible Heat Recovery Effectiveness = $(T_{o1} – T_{o2}) / (T_{o1} – T_{e1})$

where:

T_{o1} = enthalpy of outside air entering the ERU

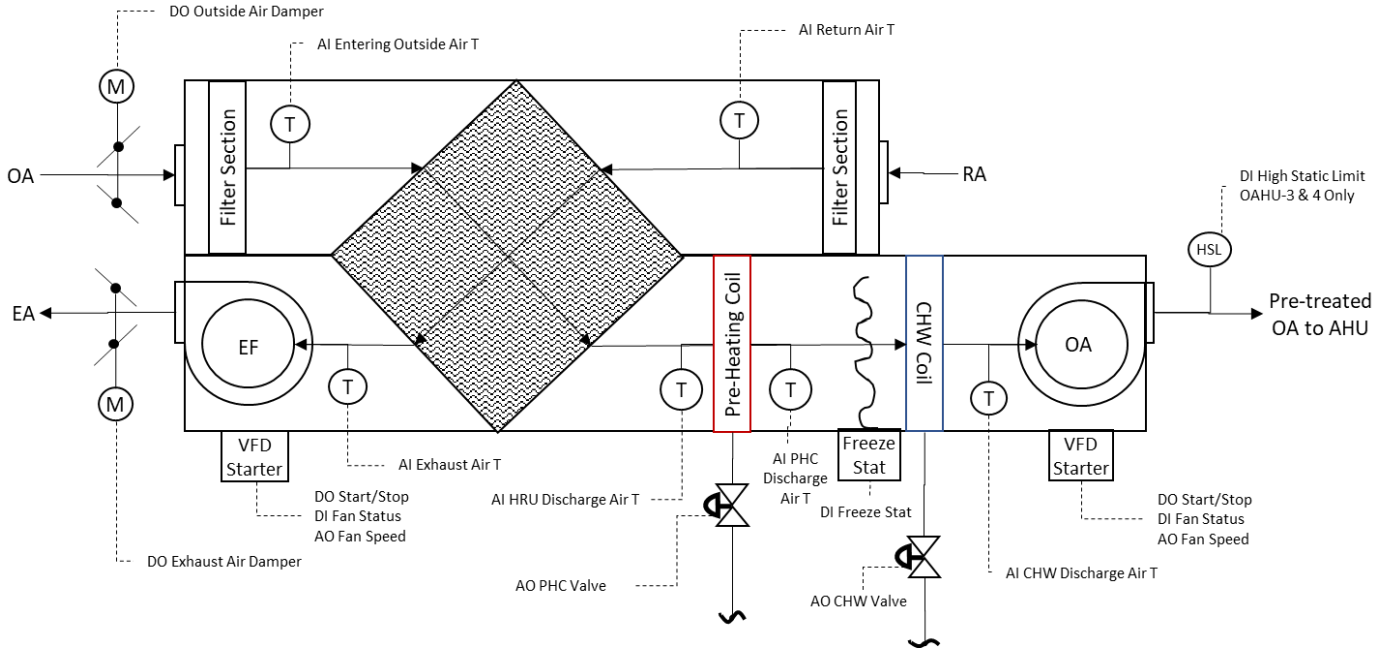
T_{o2} = enthalpy of outside air leaving the ERU

T_{e1} = enthalpy of exhaust air entering the ERU

2.4.1 – BLOCK AIR-TO-AIR HEAT EXCHANGER

Block air-to-air heat exchangers are passive devices installed in the fresh air stream and exhaust air stream, designed to transfer energy between the fresh air stream and exhaust air stream with the purpose of reducing the amount of energy required to heat and cool the outside air that must be brought into the building for ventilation purposes. The units may be furnished with a 2-position damper and/or VFD-driven fan on the exhaust side as well as the outside air side that shall be controlled by the BMCS according to the associated SF, OAHU and EF systems and sequences provided in Sections 2.1 and 2.2. The dampers shall be interlocked with associated fan operation via hardwired end-switch interlock with Fan enable circuit. They are also typically furnished with temperature and relative humidity sensors at the inlet and outlet of each air stream for the purpose of monitoring the effectiveness of the units, and should also include a differential pressure switch installed across the inlet/outlet of each stream to monitor pressure drop and provide notification via Low Priority Alarm if the pressure drop becomes too high and require cleaning.

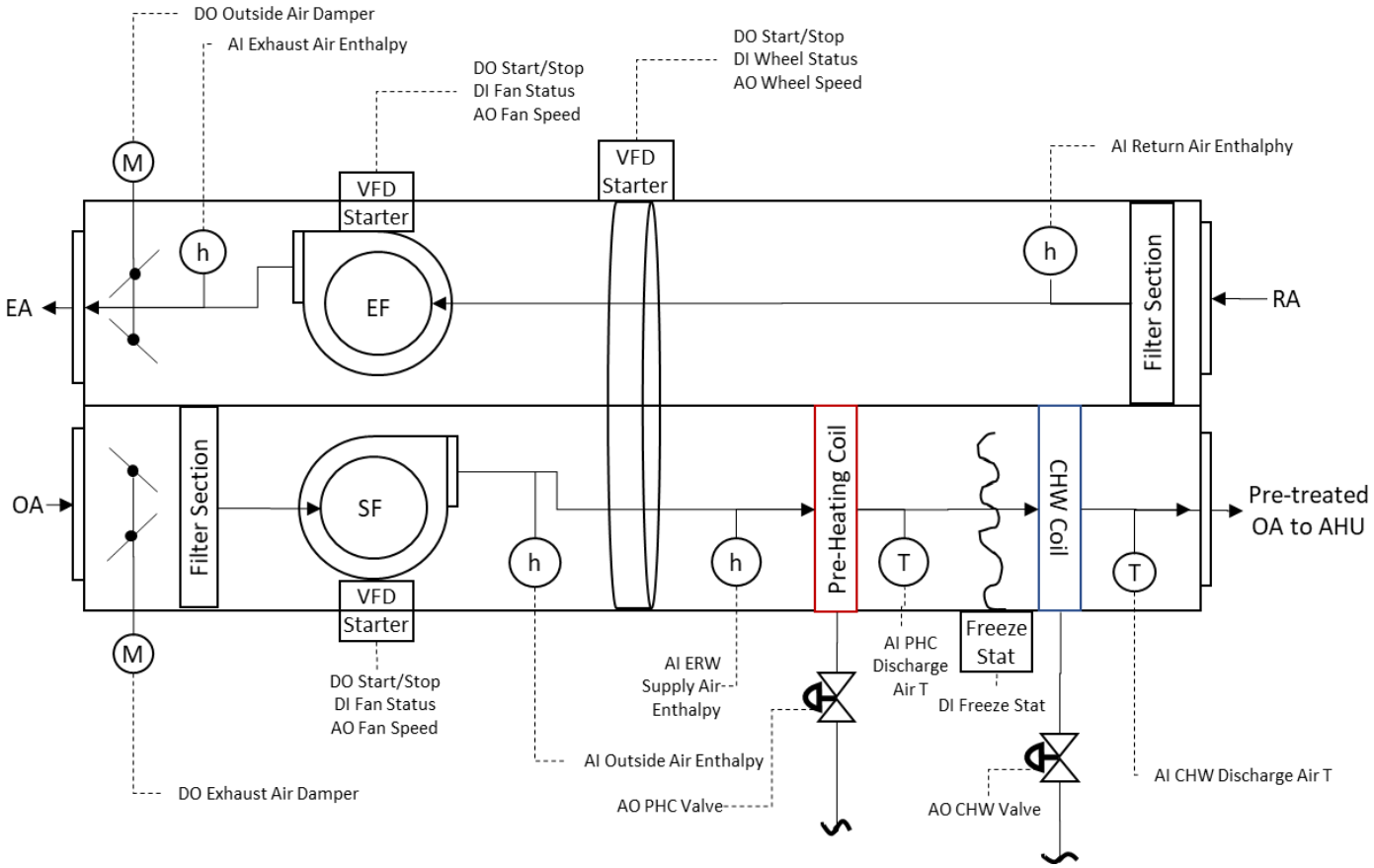
Although not the only application where block air-to-air heat exchangers are used, the following diagram depicts a bock air-to-air heat exchanger integrated into a standard OAHU. See section 2.1.1 for standard sequence of operation for this type of unit.



2.4.2 – ENERGY RECOVERY WHEEL (ERW)

Energy recovery wheels (ERW) are air-to-air heat exchangers installed in the fresh air stream and exhaust air stream, designed to transfer energy between the fresh air stream and exhaust air stream as the wheel rotates between the two streams, with the purpose of reducing the amount of energy required to heat and cool the outside air that must be brought into the building for ventilation purposes. The ERW may be furnished with a 2-position damper and/or VFD-driven fan on the exhaust side as well as the outside air side that shall be controlled by the BMCS according to the associated OAU and EF systems and sequences found in Sections 2.1 and 2.2. The dampers shall be interlocked with associated fan operation via hardwired end-switch interlock with Fan enable circuit. They are also typically furnished with temperature and relative humidity sensors at the inlet and outlet of each air stream for the purpose of monitoring the effectiveness of the ERW, and should be furnished with a differential pressure switch installed across the inlet/outlet of each stream to monitor pressure drop and provide notification via Low Priority Alarm if the pressure drop becomes too high and require cleaning.

Although not the only application where ERW's are used, the following diagram depicts an ERW integrated into a standard OAHU. See section 2.1.1 for standard sequence of operation for all components of this type of unit except for the ERW, included in this section.



Detailed Sequence

		Precool	Preheat	Default	Energy Recover Wheel	Revision History
					General	0
				X	RA Enthalpy Design Condition = 27 Btu/lb (adj)	0
				X	SA Enthalpy Design Condition = 22 Btu/lb (adj)	0
				X	Enthalpy Wheel Supply Air T HSP = PHC SP + 1°F (adj)	0
				X	**Enthalpy Wheel Control**	0
				X	In Cooling Mode	0
				X	Enable the Enthalpy Wheel when OA Enthalpy > RA Enthalpy Design Condition by 0 Btu/lb (adj)	0
				X	Enthalpy Wheel VFD Speed = 100%	0
				X	Disable the Enthalpy Wheel when OA Enthalpy falls below RA Enthalpy Design Condition by 5 Btu/lb (adj) for 5 minutes (adj)	0
				X	In Ventilation Mode	0
				X	Disable the Enthalpy Wheel	0
				X	In Heating Mode	0
				X	Enable the Enthalpy Wheel when OA Temperature < PHC SAT SP by 0°F (adj)	0

				X	Modulate the Enthalpy Wheel VFD to maintain Supply Air T at Enthalpy Wheel Supply Air T HSP, using proportional-integral control	0
				X	Disable the Enthalpy Wheel when OA Temperature rises above PHC SAT SP by 1°F (adj) for 5 minutes (adj)	0
					END OF DETAILED SEQUENCE	

GROUP 3 – CENTRAL PLANT SYSTEMS

General

This section applies to all Central Plant Systems, including but not limited to chillers, chiller auxiliary equipment, boilers, boiler auxiliary equipment, distribution pumps, etc.

Lead/Lag Staging Assignment

Note: This section shall have a dedicated Sequence Page called "Equipment Lead/Lag Staging" where "Equipment" is the applicable equipment to which the staging applies

For any equipment line-up where lead/lag staging applies, the lead/lag assignments shall be rotated on a weekly basis at an operator adjustable day and time. The default rotation time shall be

Wednesday (adj.) at 2am (adj.)

If the affected equipment is running at the time of the scheduled rotation then skip the automatic rotation and wait for the next scheduled rotation time.

The GUI shall be configured to allow a forced lead/lag rotation by the operator at any given time.

Upon failure of lead equipment to start or upon an Alarm condition of any kind, the lead/lag assignments shall be rotated, *detailed sequences are written based on this assumption*.

Upon failure of lag equipment to start or upon an Alarm condition of any kind, the equipment shall be stopped and moved to the end of the rotation (if there is more than one lag equipment), along with dedicated ancillary equipment. *For example, if the lag chiller fails to start then the chiller shall be stopped along with dedicated pumps, cooling towers, isolation valves closed, etc. and the lag staging position moved down in the rotation unless it is the only lag chiller.*

Redundant Equipment

Where equipment line-ups include redundancy, such as redundant pumps and/or chillers, the equipment shall be controlled according to the Lead/Lag assignments in the same way non-redundant equipment line-ups are controlled with the following exception: redundant equipment shall be treated as "back-up" to operating equipment and shall not be part of normal operation as it relates to staging to meet system demands, but shall be considered available in case of operating equipment failure. For example: redundant pumps shall have Lead/Lag assignments but only the Lead pump will operate at any given time, if the lead pump fails then the Lead assignment shall shift to an available pump as detailed in the Lead/Lag Assignment section of this document. The graphics shall indicate that the equipment is intended to "back-up" operating equipment

3.1 – CENTRAL CHILLED WATER (CHW) PLANT SYSTEMS

GENERAL

The following general control elements are hereby specified regardless of Chiller Plant Type, or as indicated under each subheading below.

Chiller Pump Control

Generally, chiller flow shall be controlled by the BMCS by monitoring the pump start contacts on each chiller and enabling flow through the chiller evaporator and water-cooled condenser based on a call for flow from the chiller, either by starting a pump or opening a valve or both, depending on the arrangement of the system. The outputs used to start/stop dedicated chiller pumps and/or open/close chiller isolation valves for a single chiller shall reside on the same controller that is used to monitor the chiller pump start/stop contact. The BMCS shall enable flow through any given chiller if either the chiller requests flow for any reason or the BMCS calls for flow through the chiller.

Note: In instances where chiller pump run contacts are not available or not included in the scope then pumps shall be started and stopped based on a software Pump Run Request only, as described in the detailed sequences.

Automatic Staging and State Table

The system shall be programmed to operate the chillers in one (1) of n (# of like-sized chillers) possible operating states. The states, in order of lowest to highest demand, are listed below:

- State 0 – All chillers are OFF
- State P – Pony Chiller (if equipped)
- State 1 – One (1) Chiller ON
- State 2 – Two (2) Chillers ON
- …
- State n – All (n like-sized chillers) Chillers are ON

Note: State 1 and above includes only like-sized chillers and excludes the Pony Chiller. The Pony Chiller only runs alone, it does not run when the larger chiller line-up is in operation.

All the possible states and conditions for transition up and down are summarized on the" Site Specific Plant State Tables" under each plant type section, for each applicable campus. The GUI shall display both the Commanded State # and Operating State #, defined as follows:

> Commanded State# (adj) – the State # that the plant is currently commanded to operate in. This point may be overridden by the operator.
>
> Operating State # - the State # that the system is in based on the number of chillers with chilled water flowing through them. For dedicated primary chilled water pump plants, this will correspond with primary chilled water pumps that are running as determined by pump status = ON. For headered primary chilled water pumps with chiller evaporator isolation valves, this corresponds with the number of chiller evaporator valves that are open combined with any primary pump status = ON.

The following tables shall be included on a dedicated sequence page

Chiller Commanded State Table: Commanded State = 0,P,1,2,3 (may be overridden by operator per "Manual Staging by State Override")

State	Lead	Lag	Pony	Design Flow (gpm)	Minimum Flow (gpm)	Stage-UP Demand SP (gpm)*	Stage-DN Demand SP (gpm)*
0	OFF	OFF	OFF	0	0	Cool Call	N/A
P	OFF	OFF	**ON**	*(adj)	*(adj)	*(adj)	N/A
1	**ON**	OFF	OFF	*(adj)	*(adj)	*(adj)	*(adj)
2	**ON**	**ON**	OFF	**	**	*(adj)	*(adj)
3	**ON**	**ON**	**ON**	***	***	N/A	*(adj)

** Adjustable value – use values shown in the Site-Specific Chiller Plant State Table as starting values*
*** Twice the State 1 value*
**** Three times the State 1 value*

Chiller Operating State Table: Operating State = 0,P,1,2,3 (as determined by Operating State definition above)

Chiller *	Rotation**	Command	Status	Pump Request	Flow***	Alarm Contacts	Fail to Start Alarm	Lockout
CH-1	Lead	ON/OFF	%FLA	ON/OFF	Yes/No	No/Alarm	No/Alarm	No/Lockout
CH-2	Lag 1	ON/OFF	%FLA	ON/OFF	Yes/No	No/Alarm	No/Alarm	No/Lockout
CH-3	Lag 2	ON/OFF	%FLA	ON/OFF	Yes/No	No/Alarm	No/Alarm	No/Lockout
CH-4	Pony	ON/OFF	**%FLA**	ON/OFF	Yes/No	No/Alarm	No/Alarm	No/Lockout

** Use actual chiller tags here*
*** Show actual position in line-up*
**** Flow is true if dedicated PCHWP status = ON, or if chiller evaporator isolation valve is open and any PCHWP status = ON*

Commanded Plant State vs. Operating Plant State

The GUI shall display both the Commanded Plant State and Operating Plant State, defined below.

Commanded Plant State is the Plant State that the system is commanded to be in.

Operating Plant State is the Plant State that the system is in based on the number of chillers with chilled water flowing through them. For dedicated primary chilled water pump plants, this will correspond with primary chilled water pumps that are running as determined by pump status = ON. For headered primary chilled water pumps with chiller evaporator isolation valves, this corresponds with the number of chiller evaporator valves that are open combined with any primary pump status = ON.

This distinction is especially important in primary-variable pumping arrangements with a minimum flow valve because the minimum flow valve setpoint is based on the Operating Plant State even if the Commanded Plant State differs.

Manual Staging by State # Override

Regardless of chiller plant type, the GUI shall include a manual staging feature that functions as follows. The operator may override the staging program by changing the "Commanded Plant State #" value. This manual override feature shall be Timed Override (adj) only and the maximum amount of override time shall be 2 hours (adj). Note: This does not lock the program into any given state, the automatic programming takes over upon transition to the desired state and after the adjustable Timed Override expires. Commanded Plant State shall be a timed override value from the main chiller plant graphic page(s), and shall alarm anytime this is done manually. Only one (1) state increment is allowed, for instance if plant is in State 1 then only a manual entry of State 2 would be allowed. If the Call For Cooling = 0, then no manual State entry shall be allowed. Example is shown in Figure 3-1.

Note: Even if the Commanded Plant State is manually overridden, the Operating Plant State shall display the actual Operating Plant State, as defined herein.

Chiller Disable

Regardless of chiller plant type, the GUI shall include and display Disabled status for each chiller that, when true, shall take the chiller out of the automatic staging rotation so that the system will not attempt to automatically start the chiller nor its associated equipment (isolation valves, pumps, etc.). The Disabled status shall be displayed, and the disabled chiller will not be started. Chiller "Disable" will be the sole way a chiller is to be taken out of the rotation for service or any other purpose (for this reason, there should be no reason to adjust order of the chillers). See also Figure 3-1 and associated Notes.

Chiller Alarm Handling

If a chiller does not start, or goes into alarm at any time, then the chiller plant program shall automatically roll to the next chiller (if there is another chiller available), see also "Lead/Lag Assignment" above. In all cases there shall be no manual resets required in the chiller plant programming to prevent the chiller from trying to restart again if needed (also if the plant program is calling for the down chiller and it requires an onsite reset, then upon clearing the chiller shall automatically restart without any delay or manual reset requirements from the control system).

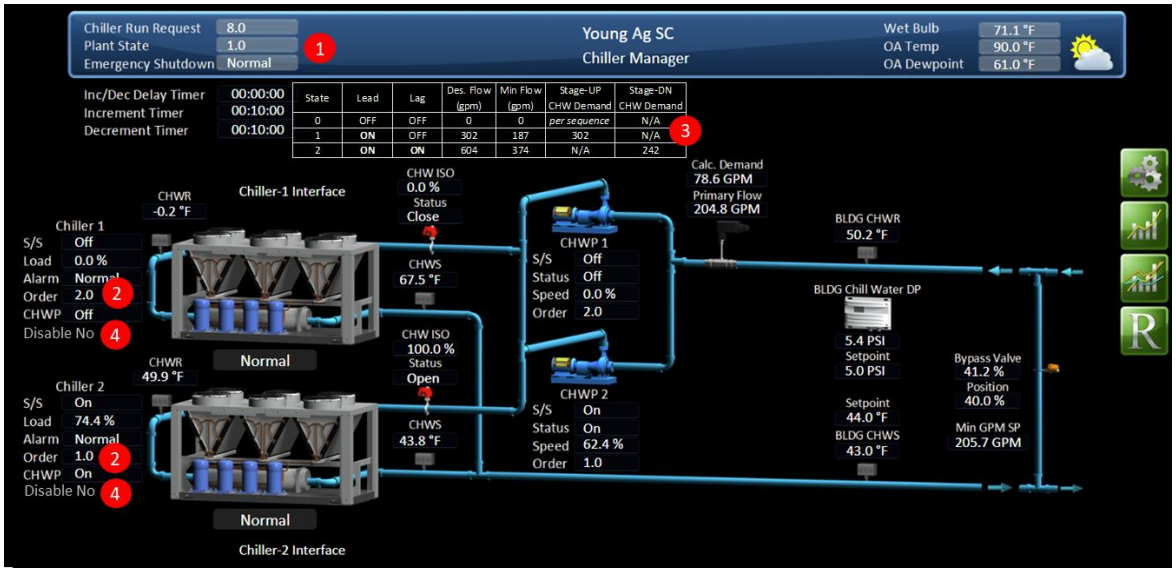
Chiller Alarm Conditions

Regardless of chiller plant type, any of the following conditions will result in a Chiller Alarm:

- Chiller Alarm Contact = On. This failure condition shall clear automatically when the chiller alarm contacts open.
- Pony Chiller Fail to Start: Pony Chiller S/S = ON & Pony Chiller Supply T > 55°F (adj) for 5 minutes (adj)
- Lead Chiller Fail to Start: Lead Chiller S/S = ON & Lead Chiller Supply T > 55°F (adj) for 5 minutes (adj)
- Lag Chiller Fail to Start: Lag Chiller Command = ON & Lag Chiller Supply T > 50°F (adj.) for 5 minutes (adj)
- Activate a Chiller Plant "Excessive Run-Time" alarm if chiller Commanded Plant State is greater than 0 for 24hrs

Alarms shall affect chiller rotation per Lead/Lag Staging Assignment, but No Alarm shall lock out any chiller from attempting to start. See also Lead/Lag Staging Assignment and Chiller Alarm Handling.

Figure 3-1: Example Chiller Plant Graphic



Notes:

1. Plant State – indicates the state of the plant. This example screen shot is from a previous version of this document and only includes “Plant State”. Include both “Commanded Plant State” and “Operating Plant State”. Manually changing the Commanded Plant State shall result in the chiller plant going to the selected state. After the Timed Override expires, the system will revert to automatic state transition per the sequence. Only next State is allowed. Operating Plant State is a function of the status of other plant equipment as defined under “Commanded Plant State vs. Operating Plant State” and should be displayed but should not be overridden.
2. Order – indicates the order of the chillers in the state table. Changing this number results in automatic change of chiller staging order if any applicable number is changed. Example: Changing Chiller 1 Order from “2” to “1” will result in Chiller 1 becoming the first chiller in the rotation and Chiller 2 becoming the second chiller in the rotation. If more than two chillers are in the lineup then all Order values shall change. Exception: If the chiller plant is equipped with a Pony Chiller, designated by “P”, the Pony Chiller may be disabled but its operating order may not be changed. This value should be display-only on the main graphic page, but shall be adjustable on the associated Sequence Page.
3. State Table – Display current Design, Min, Stage-Up, and Stage-Down value. All of these values shall be adjustable on the sequence page, but not on the main graphic page where they shall be display only.
4. Disable – indicates if the Chiller is manually disabled. This shall be used by the operators to disable any chiller from operating and therefore shall be adjustable from the equipment graphic page. If any chiller is Disabled, the staging sequence shall ignore the chiller when staging up or down and shall skip the applicable state(s).

Refrigerant Monitoring System

For Water Cooled (WC) chiller plants, or plants with refrigerant circuits located indoors, furnish and 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.

Furnish and 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 providing 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 location as per local code.

Furnish and install a clearly identified switch of the break-glass type immediately adjacent to inside and outside of each refrigeration machinery room exit for manual shut down. Label switches / buttons per Code. Provide a refrigerant ventilation button for control in the central plant. Upon alarm either through the sensor or by manually pushing the button, the refrigerant exhaust fan shall be activated and deactivate all the mechanical equipment i.e., chillers and pumps thru safety circuits upon alarm.

Furnish and install ventilation control of the exhaust and supply fans and alarm the BMCS at the Critical Alarm Level. Provide ventilation control of the exhaust and supply fans, alarm the BMCS and signal the audible and visual alarms in the area served at alarm condition number two.

Cooling Tower Fan Safety Interlocks

For water-cooled chiller plants, provide interlock wiring for the vibration sensor, oil level switch and oil pump on each cooling tower fan where applicable

Chiller BACnet Integration

Furnish and install BACnet integration means and provide one BACnet integration screen in the BAS graphics that includes the following information at a minimum.

Local/Remote mode
Active Alert/Alarm with alert/alarm code (Note: include cross-reference table for code deciphering)
Active Setpoint
Active Demand Limit
Entering / Leaving Temperatures
Evap / Cond Flow Status
Evap / Cond Pressures & Saturated Temperatures
Evap / Cond Pump Request

Running Status / Mode
%Loaded
Compressor Starts / Run Time
Compressor Discharge Pressure
Compressor Status / Current
Compressor Winding Temperature
Oil Level

Water Cooled Chiller Condenser Water Chemical Circulation

Circulate condenser water through all chiller condensers and cooling towers every Wednesday (adj) and Saturday (adj) at 2 am (adj) while Commanded Plant State = 0 for 30 minutes (adj) to circulate water and mix chemicals.

Optimized Chiller Staging

The following optimized staging sequence is intended to be applied to water-cooled chillers with VFD-driven compressors only and applies to staging of like-sized chillers in State > P, it does not apply to State P.

Optimized Staging = “ON” or “OFF” (Operator Adjustable)

If Optimized Staging = “ON” and Commanded State > P then do the following:

While CHWST < 50°F (adj), adjust the Staging SP’s as follows

Max CWST = 85°F (adj) Max Staging SP Adjustment Factor = 1.0 (adj)
Min CWST = 65°F (adj) Min Staging SP Adjustment Factor = 0.6 (adj)

As CWST goes from Max to Lift, reset “Staging SP Adjustment Factor” between Max Staging SP Adjustment Factor and Min Staging SP Adjustment Factor.

Where CWST = the Common CWST, for headered CT configurations
Where CWST = the average of all active CT CWST measurements, for dedicated Chiller/CT configurations

For any given Commanded Plant State (other than State P):

Optimized Stage UP Setpoint = Stage UP Setpoint * Staging SP Adjustment Factor
Optimized Stage DN Setpoint = Stage DN Setpoint * Staging SP Adjustment Factor

Optimized Chiller Setpoint

Note: This section shall have a dedicated Sequence Page called “Chiller Setpoint”

Optimized CHWST Setpoint = “ON” or “OFF” (Operator Selectable)

If Optimized CHWST Setpoint = ON then do the following:

Average CC DAT SP = average of all CC DAT SP's
Min CC DAT SP = minimum of all CC DAT SP's
N = 3 (adj)
Controlling CC DAT SP = Avg. + N*Min / (N+1)

Lo Controlling CC DAT SP = 60°F (adj) Min CHWST SP = 44°F (adj)
Hi Controlling CC DAT SP = 65°F (adj) Max CHWST SP = Min CHWST SP + 5°F (adj)

Set Optimized CHWST SP according to reset schedule above.

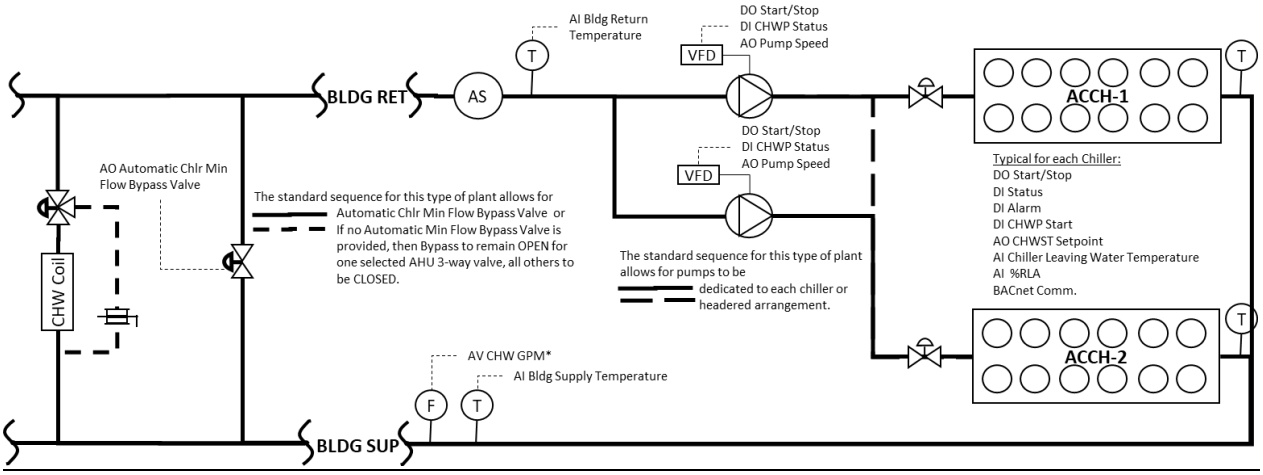
As Controlling CC DAT SP goes from Lo to Hi, set Optimized CHWST SP from Min to Max.

If Optimized CHWST Setpoint = OFF then CHWST SP = Min CHWST SP

3.1.1A – CHW PLANT TYPE 1A – AC CHILLERS w/ PRIMARY ONLY PUMPING

General

The following general diagram is for diagrammatic purposes only and includes points that may not be applicable to or needed for every system. Exact location of applicable sensors, valves, and/or components of any kind shall be coordinated with the Owner if site-specific instruction is not provided within the site-specific Contract Documents. Likewise, the sequence of operation includes instructions for components that may not be applicable to every system. However, the sequences are written so that elimination of components does not impact the sequence of operation for remaining components. Therefore, components that are not present may be treated as "Not Applicable". Note: the system may include more than two (2) chillers and/or two (2) pumps in parallel, which is accounted for in the Detailed Sequence section.



Site Specific AHU's With 3-way Valves To Remain Open

Schools that do not include an Automatic Chiller Minimum Flow Bypass Valve – For schools with variable pumping, the minimum speed to maintain minimum flow through a single operating chiller shall be

determined during commissioning by closing all CHW coil valves with one CHWP operating and reducing the speed until the flow measured by the CHW Flowmeter reads the minimum flow for one chiller plus a 10% safety margin. For either case, VFD's or no VFD's, the amount of CHW bypassed in the system shall be minimized by closing the manual valve located in the bypass leg for all but selected AHU's that have a three-way CHW control valve (prior to the minimum flow test described above). The manual valve located in the bypass leg for at least one selected AHU shall remain open and operating as a 3-way valve. The applicable AHU's and minimum flow for one chiller, along with a list of three-way valves to remain open for each campus is tabulated in the table below for each applicable campus.

The data in the table below that is greyed out applies to previous projects, the remaining data applies to the current project(s). Note: the table information may be changed during commissioning by the CxA and updated in this document for future reference of "as-built" conditions.

School	Abbr.	CHWP VFD	AHUs with 3-way valves to remain open	Sum of Design Flow for 3-way valve AHU's	Chiller Min Flow for one chiller
Example ES	*EES*	*Yes*	*AHU-E*	*215 gpm*	*200 gpm*

Site Specific Chiller Plant State Tables

The tables below that are greyed out applies to previous projects, the remaining tables apply to the current project. Note: the table information may be changed during commissioning by the CxA and updated in this document for future reference of "as-built" conditions.

EXAMPLE ELEMENTARY SCHOOL

State	Lead	Lag	Design Flow (gpm)	Min Flow (gpm)	Stage-UP Calc. Demand	Stage-DN Calc. Demand
0	OFF	OFF	0	0	*Per sequence*	N/A
1	**ON**	OFF	480 (adj)	190 (adj)	480 (adj)	N/A
2	**ON**	**ON**	960 (adj)	380 (adj)	N/A	384 (adj)

Detailed Sequence

CHW DP	Bypass Valve	Isolation Valve	VFD	Default	CHILLED WATER PLANT TYPE 1A SEQUENCE OF OPERATION - AC CHILLERS w/ PRIMARY ONLY PUMPING	Revision History
				X	**General**	**0**
				X	*Note: In the following sequence, a "Run Request" is a variable used with other variables in logic to determine when to start and/or stop associated equipment. A "Run Request" alone may or may not be adequate to start and/or stop the associated equipment, likewise a "Run Request" may not be required at all to start and/or stop the associated equipment.*	0
				X	*Note: Due to similarities between this detailed sequence and the detailed sequence of the sections that follow this one, other sections may refer to this section in lieu of repeating the same sequence of operation, therefore, In the following sequence [bracketed statements] are used to denote statements that apply only to the referenced system.*	0
				X	Lead/Lag designation:	0
				X	Upon automatic designation at adjustable scheduled intervals	0
				X	Upon manual designation	0
				X	Upon failure of Lead equipment to start	0
				X	The GUI shall include but is not limited to the following features:	0
				X	Manual staging feature as described in the Manual Staging section	0
				X	Manual lead/lag designation option	0
				X	CHW Freeze Prevention = True if OAT < 33F (adj), with 1F (adj) dead band	0
				[X]	[*For water-cooled chiller plants only:* CW Freeze Prevention = True if OAT < 33°F (adj), with 1°F (adj) dead band]	0
		X			**Chiller Evaporator Isolation Valve Control**	0
		X			Resting state for Lead Chiller Isolation Valve = Open	0
		X			The following applies to all Lag Chiller Evaporator Isolation Valves individually	0
		X			Resting state for Lag Chiller Isolation Valve = Closed	0
		X			Slowly open and close the Lag Chiller Isolation Valve 20% (adj.) every 1 min. (adj) until it is fully open	0
		X			Open the Lag Chiller Isolation Valve when ANY of the following are True	0
		X			Lag Chiller PCHWP Run Contact = ON	0
		X			Lag Chiller PCHWP Run Request = ON	0
		X			Freeze Prevention PCHWP Run Request = ON	0
		X			Close the lag Chiller Isolation Valve when ALL of the following are True	0
		X			Lag Chiller PCHWP Run Contact = OFF	0
		X			Lag Chiller PCHWP Run Request = OFF	0

		X			Freeze Prevention PCHWP Run Request = OFF	0
		X			Activate a Valve Fail to Open High Priority Alarm if Valve Command > 90% (adj) or OPEN and Valve Status = < 10% (adj) or CLOSED for 2 min. (adj)	0
				X	**PCHWP Start/Stop**	0
		X			At least one chiller evaporator automatic isolation valve must be open to run any PCHWP	0
				[X]	[*For Primary-only Pumping Systems Only:* When Cool Request > 0 (adj), set the Lead PCHWP Request = ON before starting any chillers to evaluate the Calculated CHW Demand]	0
				X	Run Lead PCHWP when ANY of the following are True	0
				X	Cool Request > 0	0
				X	Lead Chiller PCHWP Run Contact = ON	0
				X	Lead Chiller PCHWP Run Request = ON	0
				X	Freeze Prevention PCHWP Run Request = ON	0
				X	Freeze Protection PCHWP Run Request = ON	0
				X	Stop Lead PCHWP when ALL of the following are True	0
				X	Cool Request = 0 for 5 min. (adj)	0
				X	Lead Chiller PCHWP Run Contact = OFF	0
				X	Lead Chiller PCHWP Run Request = OFF for 3 min. (adj)	0
				X	Freeze Prevention PCHWP Run Request = OFF	0
				X	Freeze Protection PCHWP Run Request = OFF	0
				X	The following applies to ALL Lag PCHWP's individually	0
				X	Run Lag PCHWP when ANY of the following are True	0
				X	Lag Chiller PCHWP Run Contact = ON	0
				X	Lag Chiller PCHWP Run Request = ON	0
				X	Freeze Prevention PCHWP Run Request = ON	0
				X	Stop Lag PCHWP when ALL of the following are True	0
		X			Lag Chiller Isolation Valve Status = Closed	0
				X	Lag Chiller PCHWP Run Contact = OFF	0
				X	Lag Chiller PCHWP Run Request = OFF for 3 min. (adj)	0
				X	Freeze Prevention PCHWP Run Request = OFF	0
				X	For all PCHWP's:	0
				X	Freeze Prevention PCHWP Run Request = ON if ANY of the following are True for 60 min. (adj)	0
				X	CHW Freeze Prevention = True	0
				X	Any CHW temperature sensor < 35°F (adj)	0
				X	Freeze Prevention PCHWP Run Request = OFF if ALL of the following are True for 10 min. (adj)	0
				X	All CHW temperature sensors > 35°F (adj)	0
				X	Freeze Protection PCHWP Run Request = ON if ANY AHU Low Limit Switch (Freeze Stat) = ON	0
				X	Freeze Protection PCHWP Run Request = OFF if ALL AHU Low Limit Switch (Freeze Stat) = OFF for 10 min. (adj)	0
				X	Activate a Pump Fail to Run Low Priority Alarm if Pump Command = ON and Pump Status = OFF for 2 min. (adj).	0

				X	Activate a Pump in Hand Low Priority Alarm if Pump Command = OFF and Pump Status = ON for 2 min. (adj)	0
			X		**PCHWP Speed (Process Variable = Controlling CHW Valve Position)**	0
			X		PCHWP Minimum Speed = 33% (adj) *Note: This value shall be determined by closing all CHW valves and determining the speed required of one pump to maintain minimum flow through one chiller, and with automatic chiller min flow bypass open 100% if applicable.*	0
			X		Override Minimum PCHWP Speed to 75% (adj) while Freeze Protection PCHWP Run Request = ON	0
			X		All running PCHWP's shall run at the same speed	0
			X		On initial plant startup, set PCHWP Speed to PCHWP Min Speed	0
			X		Adjust CHW Pump Speed every 1 min. (adj) between Min and Max as follows:	0
			X		While the Controlling CHW Valve Position < 40% (adj), decrease VFD Speed by 3% (adj)	0
			X		While the Controlling CHW Valve Position > 80% (adj), increase VFD Speed by 5% (adj)	0
			X		**PCHWP Speed (Process Variable = Bldg CHW Differential Pressure)**	0
			X		PCHWP Minimum Speed = 33% (adj) *Note: This value shall be determined by closing all CHW valves and hold the minimum flow valve open at 100% (if equipped). Run one pump and increase the speed gradually until minimum chiller flow is achieved. Set the PCHWP Minimum Speed to the speed corresponding with minimum chiller flow.*	0
			X		Min CHW DP SP = 5 psid (adj) *Note: Set the minimum DP by closing all CHW valves in the system and hold the minimum flow valve open at 100%. Run one pump and increase the speed gradually until minimum chiller flow is achieved. Set the minimum DP at the value corresponding with minimum chiller flow.*	0
			X		Override Minimum CHW DP SP to 10psid (adj) while Freeze Protection PCHWP Run Request = ON	0
			X		Max CHW DP SP = 20 psid (adj)	0
			X		All running PCHWP's shall run at the same speed	0
			X		On initial plant startup, set CHW DP SP = Min CHW DP SP	0
			X		Control CHW Pump VFD Speed to maintain CHW DP at CHW DP SP using tuned PI loop control	0
			X		Adjust CHW DP SP every 1 min. (adj) between Min and Max as follows:	0
			X		While the Controlling CHW Valve Position < 40% (adj), decrease CHW DP SP by 1psid (adj)	0
			X		While the Controlling CHW Valve Position > 80% (adj), increase CHW DP SP by 3psid (adj)	0
				X	**Chiller Start/Stop**	0
				X	Cold Start Minimum Demand = TBD* (adj) **This value is to be programmed for ALL chilled water plants (INCLUDING air-cooled chiller plants) although this feature was added for water-cooled chiller plants that must have a minimum amount of load to heat up the condenser water loop on cold mornings when*	0

					the condenser water temperature is below the minimum to allow a chiller to successfully start and run. For Air-Cooled Chillers the value may be set to zero (0).	
				[X]	[*For WC chiller plant with AC Pony:* Start the Pony Chiller and set Pony PCHWP Request = ON when ALL of the following are True]	0
				[X]	[Cool Request > 0 (adj)]	0
				[X]	[Calculated Demand is less than either of the following]	0
				[X]	[State P Stage-UP Demand SP]	0
				[X]	[WC Cold Start Minimum Demand]	0
				[X]	[*For WC chiller plant with AC Pony:* Stop the Pony Chiller and set Pony PCHWP Request = OFF when ANY of the following are True]	0
				[X]	[Cool Request = 0 (adj)]	0
				[X]	[Calculated Demand is greater than both of the following]	0
				[X]	[State P Stage-Up Demand SP]	0
				[X]	[WC Cold Start Minimum Demand]	0
				X [X]	Start the Lead Chiller and set Lead PCHWP Run Request = ON [and set Lead CWP Run Request = ON *for water-cooled chillers not equipped with CWP Run Contact*] when ALL the following are True	0
				X	*For Primary-only Pumping systems:* Lead PCHWP Status = ON for 5 minutes (adj)	0
				[X]	[*For Primary/Secondary Pumping systems*: Any SCHWP Status = ON for 5 minutes (adj)]	0
				X	Cool Request > 0 (adj)	0
				[X]	[*For water-cooled chillers*, the following must ALSO be TRUE]	0
				[X]	[*For WC chiller plant with AC Pony*: Calculated Demand > State P Stage-Up Demand SP	0
				[X]	[CWST check is complete (CWP run for 2 minutes to check CT basin temperature)]	0
				[X]	[ANY of the following is True]	0
				[X]	[CWST > Cold Tower Warmup Setpoint - 5°F (adj)]	0
				[X]	[Calculated Demand > Cold Start Minimum Demand]	0
				X [X]	Stop the Lead Chiller and set Lead PCHWP Run Request = OFF [and set Lead CWP Run Request = OFF *for water-cooled chiller if chiller is not equipped with CWP Run Contact*] when Cooling Request = 0 (adj) for 5 minutes (adj)	0

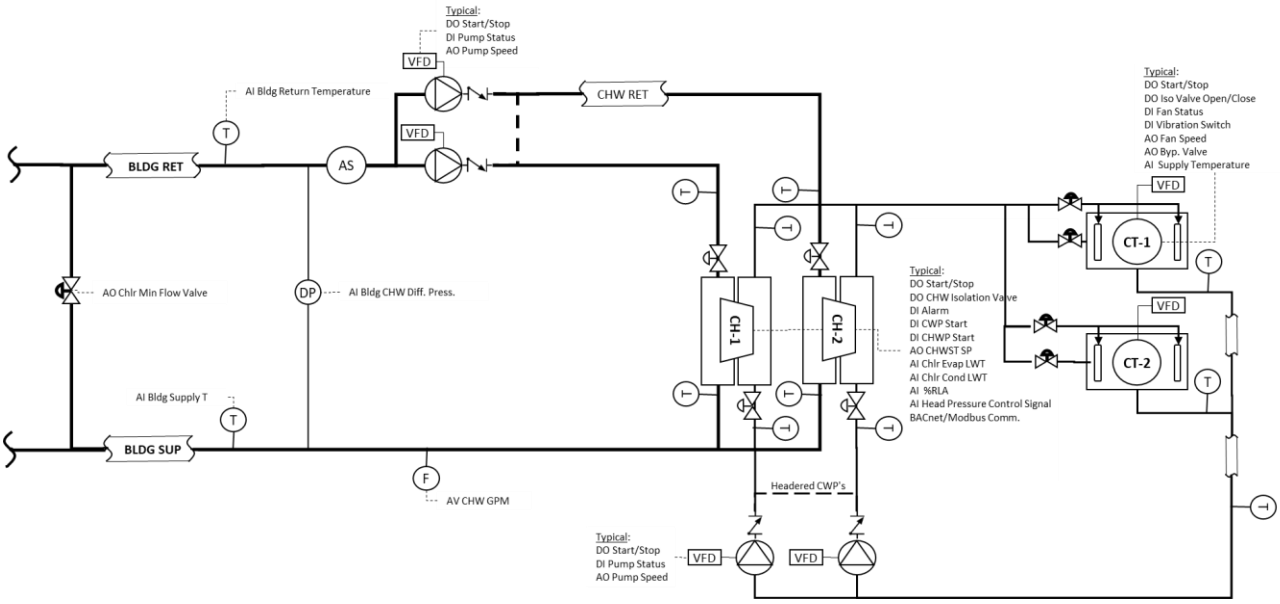
				X	The following applies to each Lag Chiller individually	0
				X	Start the Lag Chiller and set associated Lag PCHWP Run Request = ON [and set Lag CWP Run Request = ON *for water-cooled chillers if chiller is not equipped with CWP Run Contact*] when Calculated CHW Demand > Stage UP Flow SP (adj) for 15 minutes (adj)	0
				X	Stop the Lag Chiller and set associated Lag PCHWP Run Request = OFF [and set Lag CWP Run Request = OFF *for water-cooled chiller if chiller is not equipped with CWP Run Contact*] when Calculated CHW Demand < Stage DN Flow SP (adj) for 5 minutes (adj)	0
				X	Activate a Chiller Fail to Run Critical Priority Alarm if ANY the following are true	0
				X	Chiller Alarm is true (contacts closed)	0
				X	Chiller Command = ON and Chiller Status = OFF and Chiller Supply T > 65°F (adj) after 10-minute (adj) time delay	0
				X	Chiller Command = ON and PCHWP Run Contact = OFF after a 10-minute (adj) time delay (*NOTE: if the chiller(s) does not have this feature or if it is determined that the pump run contacts are not working then do not include this*)	0
	X				**Chiller Minimum Flow Bypass Valve Control**	0
	X				Resting state for Min Flow Valve position = 50% open (adj)	0
	X				While ANY PCHWP Status = ON	0
	X				*Preferred Method:* Min Flow Valve position = Tuned PI control loop output with the following parameters:	0
	X				Setpoint = Min CHW Flow + 10% (adj). See Chiller Staging table for Min CHW Flow value for any given Operating Plant State. *Note: The State number used to determine Minimum Flow Setpoint should be the actual Operating Plant State of the plant in terms of flow requirement. In other words, the minimum flow setpoint should match the number of chillers that actually have flow, whether the chillers that have flow are operating or not. For plants that have isolation valves then the operating state is related to the number of automatic isolation valves that are open combined with primary pump status. For plants that have dedicated chiller evaporator pumps then the operating state is related to the number of chiller evaporator pumps running.*	0
	X				Bias = the output of a linear reset, 0 – 100% (adj) open as the Calculated CHW Demand goes from Min CHW Flow to 0 gpm (adj). See Chiller Staging table for Min CHW Flow value for any given operating state	0
	X				*Alternative Method (to be used in instances where PI Loop "stacking" negates the effect of a step change in Bias on the loop output when Calculated Demand falls below in CHW Flow):* Min Flow Valve position = Maximum of the following two outputs	0

	X					Tuned PI control loop with setpoint = Min CHW Flow + 10% (adj). See Chiller Staging table for Min CHW Flow value for any given operating state	0
	X					Reset schedule: Valve = 0 to 100% (adj) open as the Calculated CHW Demand goes from Min CHW Flow to 0 gpm (adj). See Chiller Staging table for Min CHW Flow value for any given operating state	0
					END OF DETAILED SEQUENCE		

3.1.1B – CHW PLANT TYPE 1B – WC CHILLERS & AC Pony w/ PRIMARY ONLY PUMPING

General

The following general diagram is for diagrammatic purposes only and includes points that may not be applicable to or needed for every system. Exact location of applicable sensors, valves, and/or components of any kind shall be coordinated with the Owner if site-specific instruction is not provided within the Drawings and Specifications. Likewise, the sequence of operation includes instructions for components that may not be applicable to every system. However, the sequences are written so that elimination of components does not impact the sequence of operation for remaining components. Therefore, components that are not present may be treated as "Not Applicable". Note: the system may include more than two (2) chillers and/or two (2) pumps in parallel, which is accounted for in the Detailed Sequence section.



Site Specific AHU's With 3-way Valves to Remain Open

Schools that do not include an Automatic Chiller Minimum Flow Bypass Valve – For schools with variable pumping, the minimum speed to maintain minimum flow through a single operating chiller shall be determined during commissioning by closing all CHW coil valves with one CHWP operating and reducing the speed until the flow measured by the CHW Flowmeter reads the minimum flow for one chiller plus a 10% safety margin. For either case, VFD's or no VFD's, the amount of CHW bypassed in the system shall be minimized by closing the manual valve located in the bypass leg for all but selected AHU's that have a three-way CHW control valve (prior to the minimum flow test described above). The manual valve located in the bypass leg for at least one selected AHU shall remain open and operating as a 3-way valve. The applicable AHU's and minimum flow for one chiller, along with a list of three-way valves to remain open for each campus is tabulated in the table below for each applicable campus.

The data in the table below that is greyed out applies to previous projects, the remaining data applies to the current project. Note: the table information may be changed during commissioning by the CxA and updated in this document for future reference of "as-built" conditions.

School	Abbr.	CHWP VFD	AHUs with 3-way valves to remain open	Sum of Design Flow for 3-way valve AHU's	Chiller Min Flow for one chiller
Example ES	*EES*	*Yes*	*None*	*0 gpm*	*196 gpm*

Site Specific Chiller Plant State Tables

The tables below that are greyed out applies to previous projects, the remaining tables apply to the current project. Note: the table information may be changed during commissioning by the CxA and updated in this document for future reference of "as-built" conditions.

EXAMPLE ES

State	Lead	Lag	Design Flow (gpm)	Min Flow (gpm)	Stage-UP Bldg. Flow (gpm)*	Stage-DN Bldg. Flow (gpm)*
0	OFF	OFF	0	0	Cool Call, 150(adj)***	N/A
1	**ON**	OFF	500	330	500(adj)**	N/A
2	**ON**	**ON**	1000	660	N/A	400(adj)**

** Stage UP and Stage DN Bldg. Flow are based on calculated demand.*
***The stage-up and stage-down values shown here are starting points and may be adjusted in the field during tuning.*
****If the OAT < 40F at start-up then run CHWP's & CWP's but do not start the lead water-cooled chiller until Calculated Demand > the adjustable gpm setpoint indicated or the cooling tower supply leaving water temperature > cooling tower bypass setpoint. This condition shall be ignored after chiller plant is successfully started.*

Detailed Sequence

CHW DP	Bypass Valve	Isolation Valve	VFD	Default	CHILLED WATER PLANT TYPE 1B SEQUENCE OF OPERATION – WC CHILLERS w/ PRIMARY ONLY PUMPING	Revision History
				X	**General – See Section 3.1.1A**	**0**
		X			**Chiller Evaporator Isolation Valve Control – See Section 3.1.1A**	0
				X	**PCHWP Start/Stop – See Section 3.1.1A**	0
			X		**PCHWP Speed (Process Variable = Controlling CHW Valve Position) – See Section 3.1.1A**	0
			X		**PCHWP Speed (Process Variable = Bldg CHW Differential Pressure) – See Section 3.1.1A**	0
				X	**Chiller Start/Stop – See Section 3.1.1A**	0
	X				**Chiller Minimum Flow Bypass Valve Control – See Section 3.1.1A**	0
		X			**Chiller Condenser Isolation Valve**	0
		X			Resting state for lead chiller condenser isolation valve = Open	0
		X			Resting state for lag chiller condenser isolation valve = Closed	0
		X			Open the lag chiller condenser isolation valve when Lag CWP Request = ON	0
		X			Close lag CW isolation valve when Lag CWP Run Request = OFF	0
		X			Whenever opening or closing the lag CW isolation valve, open/close the valve slowly, 20% (adj.) every 1 minute (adj) until it is fully open (or as slow as necessary to keep lead chiller from tripping on loss of flow)	0
	X				Activate a Valve Fail to Open High Priority Alarm if Valve Command > 90% (adj) or OPEN and Valve Status = < 10% (adj) or CLOSED for 2 min. (adj)	0
				X	**Condenser Water Pump Start/Stop**	0
		X			The Lead Chiller condenser automatic isolation valve must be open to run the Lead CWP	0
				X	On transition from State 0 to State 1 or from State P to State 1, set Lead CWP Run Request = ON for 2 minutes (adj.) prior to starting the Lead Chiller, to evaluate cooling tower basin temperature.	0
				X	Run Lead CWP when (Lead CT isolation valve > 50% (adj) or Lead CT basin valve > 50% open) and ANY of the following are True	0
				X	Lead CWP Run Contact = ON	0
				X	Lead CWP Run Request = ON	0
				X	Freeze Prevention CWP Run Request = ON	0
				X	Freeze Protection CWP Run Request = ON	0
				X	Stop Lead CWP when ALL of the following are True	0
				X	Lead CWP Run Contact = OFF	0
				X	Lead CWP Run Request = OFF for 3 min. (adj)	0
				X	Freeze Prevention CWP Run Request = OFF	0
				X	Freeze Protection CWP Run Request = OFF	0

				X	The following applies to ALL Lag CWP's individually	0
		X			The Lag Chiller condenser automatic isolation valve must be open to run the Lag CWP	0
				X	Run Lag CWP when Lag CT isolation valve is open and ANY of the following are True	0
				X	Lag Chiller CWP Run Contact = ON (if chiller is equipped with CWP Run Contact)	0
				X	Lag Chiller CWP Run Request = ON (if chiller is not equipped with CWP Run Contact)	0
				X	Freeze Prevention CWP Run Request = ON	0
				X	Stop Lag CWP when ALL of the following are True	0
		X			Lag Chiller Isolation Valve Status = Closed	0
				X	Lag Chiller CWP Run Contact = OFF (if chiller is equipped with CWP Run Contact)	0
				X	Lag Chiller CWP Run Request = OFF for 3 min. (adj) (if chiller is not equipped with CWP Run Contact)	0
				X	Freeze Prevention CWP Run Request = OFF	0
				X	While Cool Request = 0 and CW Freeze Prevention = True	0
				X	If both CWP's are OFF for 60 min (adj) Then	0
				X	Start both CWP's	0
				X	If either CWP has been running for 10 min. (adj) Then	0
				X	If CWST > 33F (adj) Then Stop both CWP's	0
				X	Activate a CWP Low Priority Alarm if Command = ON and Status = OFF after 1-minute (adj) time delay	0
			X		**Condenser Water Pump Speed**	0
			X		Max CWP speed = 100% (adj), this will be adjusted during commissioning for design chiller CW flow rate.	0
			X		Min CWP speed = 80% (adj) of Max CWP Speed	0
			X		** NOTE: 80% of Max CWP Speed is intended to correspond with 80% of design CT flow rate that is sized for operation with one matched chiller. This can be set lower if the cooling tower nozzles can perform at the lower flow rates than 80% of design, down to the minimum flow limit of the chiller condenser. If the tower is not designed with variable flow nozzles, 80% of design flow will not significantly impact performance of nozzles designed for constant flow if the tower is sized appropriately for the application but will result in significantly lower CWP power consumption when possible.*	0
			X		For headered chiller condensers served by headered cooling towers: Operating Chiller Condenser Water Delta-T = Max Operating Chiller Condenser LWT – Condenser EWT	0
			X		For individual condenser(s) served by dedicated pump and cooling tower(s): Operating Chiller Condenser Water Delta-T = Chiller Condenser LWT – Condenser EWT	0
			X		On transition from lead chiller Disabled to Enabled, set CWP speed to Min CWP Speed for 5 minutes (adj, start-up period):	0

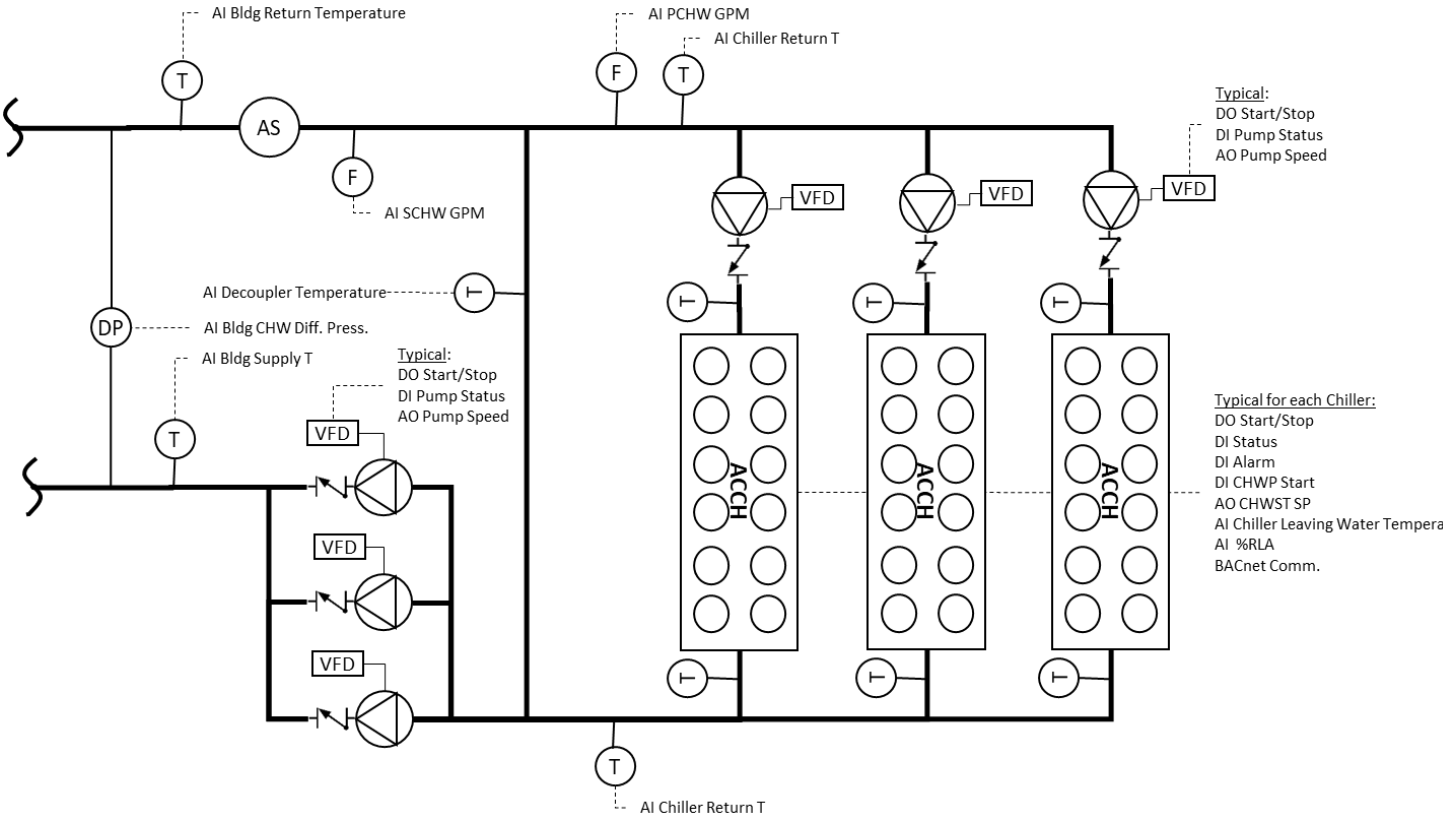
			X		After the initial start-up period, adjust CWP VFD speed between Min CWP Speed and Max CWP Speed to keep Cooling Water delta-T within a specified range as follows:	0
			X		Adjust VFD Speed between Min and Max as follows, every 1 minute (adj)	0
			X		While Operating Chiller Condenser Water Delta-T < 8°F (adj), decrease VFD Speed by 1% (adj)	0
			X		While Operating Chiller Condenser Water Delta-T > 10°F (adj), increase VFD Speed by 5% (adj)	0
			X		While chiller(s) is(are) OFF, If CWP(s) is(are) running due to Freeze Prevention, run CWP(s) at 50% (adj).	0
				X	**Cooling Tower**	0
				X	Min CWST Setpoint = 65°F (adj)	0
				X	Max CWST Setpoint = 85°F (adj)	0
				X	Cold Tower Warmup Setpoint = 60°F (adj)	0
				X	CW Freeze Prevention Setpoint = 33°F (adj)	0
				X	Provide the option for all Cooling Towers to be operated as one when any (combination of) chiller(s) is(are) running. If the option is selected, then [bracketed] information applies in the sequence below. If the option is not selected, then the [bracketed] information does not apply.	0
				X	Enable [all] cooling tower[s] immediately when ANY are True	0
				X	Associated [Any] chiller CWP Request is ON	0
				X	Associated [Any] Chiller Request is ON	0
				X	Associated [Any] CWP Status = ON	0
				X	Disable [all] Cooling Tower [s] when ALL are True	0
				X	Associated [Any] chiller CWP Request is OFF	0
				X	Associated [Any] Chiller Request is OFF	0
				X	Associated [Any] chiller CWP Status is [are] OFF	0
				X	Activate a CT Fan Low Priority Alarm if Command = ON and Status = OFF after 1-minute (adj) time delay	0
				X	**Cooling Tower Bypass Valve**	0
				X	In general, resting state shall be 100% Open. For headered towers not hydraulically dedicated to a specific CWP, the following shall apply:	0
				X	If all CT's are disabled, the resting state for each bypass valve shall be 100% Open (adj). (Note: for 3-way valves, starting adjustable value should be 50%)	0
				X	If at least one CT is enabled, the resting state for disabled CT's shall be Bypass Valve Closed	0
				X	If at least one CT is enabled and CW Freeze Prevention is True, the resting state for disabled CT's shall be Bypass Valve 20% Open (adj)	0
				X	While Cooling Tower is Enabled, Position Cooling Tower Bypass Valve[s] as follows:	0
				X	100% Bypass @ CT LWT = Cold Tower Warmup Setpoint	0
				X	0% Bypass @ CT LWT = Cold Tower Warmup Setpoint + 3°F	0
				X	**Cooling Tower Isolation Valve**	0

				X	In general, resting state shall be 100% Open (adj)	0
				X	If all CT's are disabled, the resting state for each CT shall be Isolation Valve Open.	0
				X	If at least one CT is enabled, the resting state for disabled CT's shall be isolation Valve Closed.	0
				X	While any Cooling Tower[s] is [are] Active	0
				X	Close the CT isolation valve[s] if ALL are True	0
				X	CT bypass valve is > 95% Open (adj)	0
				X	CWST < Cold Tower Warmup Setpoint - 3°F(adj)	0
				X	Open the CT isolation valve[s] if CWST > Cold Tower Warmup Setpoint	0
				X	*Note: The above logic for CT isolation valve is for cooling towers with independently operating isolation valve and bypass valve, it is not necessary if the isolation and bypass are installed as a 3-way valve with single modulating actuator*	0
				X	**Cooling Tower Fan Start/Stop**	0
				X	On initial startup of Cooling Tower[s], set CWST Setpoint to OA wbT + 5°F *Note: For cooling tower fan(s) equipped with VFD(s), this is a starting point only, for the remainder of the time that the cooling tower is enabled, the CWST SP shall follow the sequence below under "Cooling Tower Fan Speed".*	0
				X	Upon Cooling Tower Enable, the CT Fan should remain Off until the CWST rises above the initial CWST SP determined above.	0
				X	*For each cooling tower individually*, start CT Fan when CWST rises above CWST SP by 3°F (adj.) *This is so that headered towers with fans that are not equipped with VFD's may be staged by setting the adjustable offset temperatures to different values.*	0
				X	*For each cooling tower individually*, stop the Cooling Tower Fan if CWST < Min CWST Setpoint - 3°F (adj) *This is so that headered towers with fans that are not equipped with VFD's may be staged by setting the adjustable offset temperatures to different values.*	0
				X	**Cooling Tower Fan Speed**	0
				X	Modulate CT Fan Speed between Min and Max using PI Control to maintain CWST SP	0
				X	Adjust CWST Setpoint between Min and Max as follows, every 5 minutes (adj)	0
				X	While Cooling Tower Fan Speed < 55% (adj) decrease the CWST SP by 2°F (adj)	0
				X	While Cooling Tower Fan Speed > 85% (adj) increase the CWST SP by 1°F (adj)	0
					END OF DETAILED SEQUENCE	

3.1.2A – CHW PLANT TYPE 2A – AC CHILLERS w/ DECOUPLED PRIMARY AND SECONDARY PUMPING

General

The following general diagram is for diagrammatic purposes only and includes points that may not be applicable to or needed for every system. Exact location of applicable sensors, valves, and/or components of any kind shall be coordinated with the Owner if site-specific instruction is not provided within the site-specific Contract Documents. Likewise, the sequence of operation includes instructions for components that may not be applicable to every system. However, the sequences are written so that elimination of components does not impact the sequence of operation for remaining components. Therefore, components that are not present may be treated as "Not Applicable". Note: the system may include more than three (3) chillers and/or three (3) primary pumps and/or three (3) secondary pumps in parallel, which is accounted for in the Detailed Sequence section.



Secondary Loop Minimum Flow

The purpose of this sequence is to keep CHW flowing through the farthest parts of the system when the loads are very low, such as upon start up when only one or two AHU's are on.

For Primary-Secondary systems only, choose one AHU near the end of the secondary loop and add the following logic to the CHW valve control.

If AHU is OFF then do the following

Open the CHW valve linearly according to the reset table below

Total CHW Demand	CHW Valve Position
50 gpm (adj)	0%
0 gpm (adj)	100% (adj)

Provide a separate sequence page for the above sequence on the selected AHU.

Site Specific Chiller Plant State Tables

The tables below that are greyed out applies to previous projects, the remaining tables apply to the current project. Note: the table information may be changed during commissioning by the CxA and updated in this document for future reference of "as-built" conditions.

EXAMPLE SCHOOL

State	Lead	Lag1	Lag2	Design Flow (gpm)	Minimum Flow (gpm)	Stage-UP Demand SP (gpm)*	Stage-DN Demand SP (gpm)*
0	OFF	OFF	OFF	0	0	0(adj)**	N/A
1	**ON**	OFF	OFF	270	180	270(adj)**	N/A
2	**ON**	**ON**	OFF	540	360	540(adj)**	216(adj)**
3	**ON**	**ON**	**ON**	810	540	N/A	432(adj)**

** Stage UP and Stage DN Bldg. Flow are based on calculated demand.*
***The stage-up and stage-down values shown here are starting points and may be adjusted in the field during tuning.*

Detailed Sequence

CHW DP	Evap Isolation	Cond Isolation	VFD	Default	AC CHILLERS w/ DECOUPLED PRIMARY AND SECONDARY PUMPING	Revision History
				X	**General – See Section 3.1.1A**	0
				X	**SCHWP Start/Stop**	0
				X	When Cool Request > 0 (adj), set the Lead SCHWP Run Request = ON and run for 5 minutes (adj) before starting any chillers to evaluate the Calculated CHW Demand	0
				X	Run Lead SCHWP when ANY of the following are True	0
				X	Lead SCHWP Run Request = ON	0
				X	Cool Request > 0	0

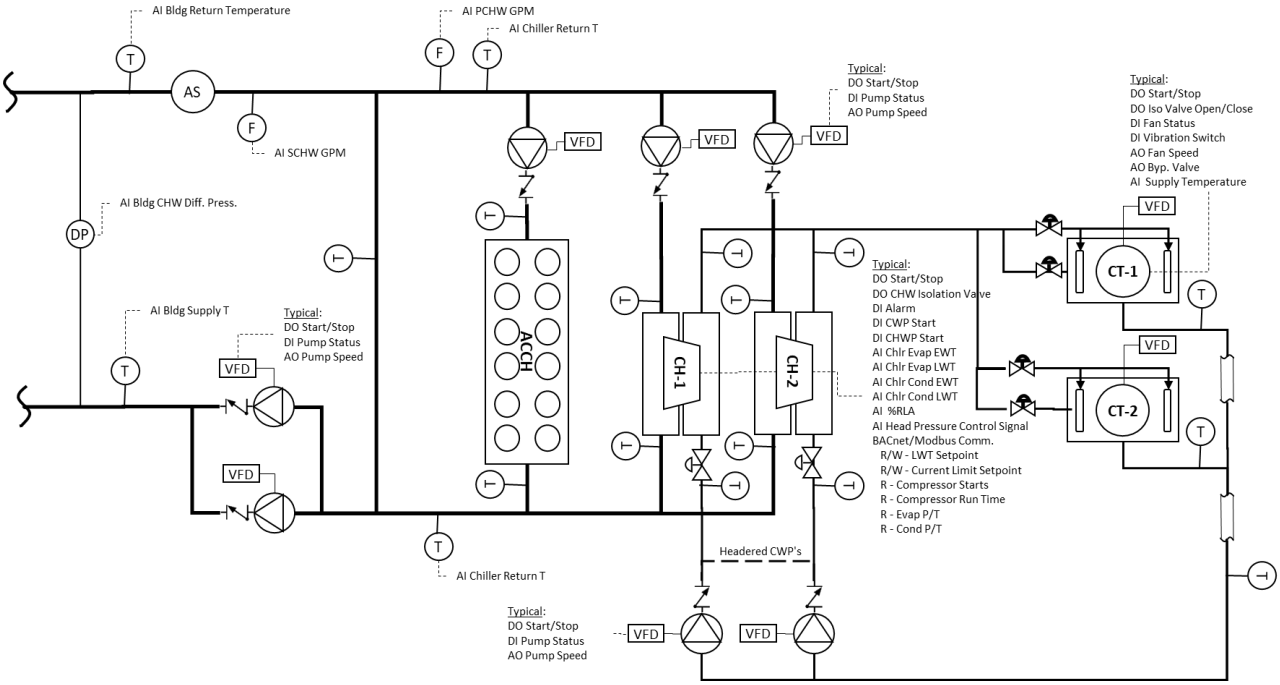
				X	Freeze Protection SCHWP Run Request = ON	0
				X	Stop Lead SCHWP when ALL of the following are True	0
				X	Cool Request = 0 for 10 min. (adj)	0
				X	Freeze Protection SCHWP Run Request = OFF	0
				X	Run Lag SCHWP when Bldg DP < Bldg CHW DP SP * 0.8 (adj) AND Lead SCHWP Speed > 90% (adj) for 1 minute (adj)	0
				X	Stop Lag SCHWP when Bldg DP > Bldg CHW DP SP * 1 (adj) AND SCHWP Speed < 50% (adj) for 1 minute (adj)	0
				X	For all SCHWP's:	0
				X	Freeze Protection SCHWP Run Request = ON if ANY AHU Low Limit Switch (Freeze Stat) = ON	0
				X	Freeze Protection SCHWP Run Request = OFF if ALL AHU Low Limit Switch (Freeze Stat) = OFF for 10 min. (adj)	0
				X	Activate a Pump Fail to Run Low Priority Alarm if Pump Command = ON and Pump Status = OFF for 2 min. (adj)	0
				X	Activate a Pump in Hand Low Priority Alarm if Pump Command = OFF and Pump Status = ON for 2 min. (adj)	0
			X		**SCHWP Speed**	0
			X		Min SCHWP Speed = 33% (adj)	0
			X		Max SCHWP Speed = 100% (adj)	0
			X		Min SCHW DP Setpoint = 5psid (adj)	0
			X		Max SCHW DP Setpoint = 20psid (adj)	0
			X		On initial plant start-up, set the SCHW DP Setpoint to Minimum SCHW DP Setpoint	0
			X		All Running SCHWP's shall run at the same speed	0
			X		Modulate SCHWP VFD speed to maintain DP Setpoint using PI loop control	0
			X		Adjust CHW Differential Pressure Setpoint every 1 min. (adj) between Min and Max as follows:	0
			X		While the Controlling CHW Valve Position* < 40% (adj)	0
			X		Decrease Differential Pressure Setpoint by 1psid (adj)	0
			X		While the Controlling CHW Valve Position* > 80% (adj)	0
			X		Increase Differential Pressure Setpoint by 3psid (adj)	0
			X		**Note: Controlling CHW Valve Position is determined using equation for Controlling Value and based on the Max CHW Valve position and Avg CHW Valve position for all CHW Valves in the system. Each CHW Valve shall be individually selectable from a summary page to be included or excluded from the calculation.*	0
			X		If Freeze Protection SCHWP Run Request = ON then override Minimum SCHWP Speed to 50% (adj) and Minimum CHW DP SP to 10psid (adj)	0
	X				**Chiller Evaporator Isolation Valve – See Section 3.1.1A**	0
				X	**PCHWP Start/Stop – See Section 3.1.1A**	0
			X		**PCHWP Speed**	0

			X		Minimum PCHWP Speed = 50% (adj) *Note: Final value to be determined by opening all Chiller Evaporator Isolation Valves and running all PCWHP's, adjust PCHWP Speed until speed required to maintain minimum flow through all Chillers is determined.*	0
			X		Max PCHW Pump Speed = 100% (adj) *Note: Final value to be determined by opening all Chiller Evaporator Isolation Valves and running all PCWHP's, adjust PCHWP Speed until speed required to maintain design flow through all Chillers is determined.*	0
			X		All running PCHWP's shall run at the same speed	0
			X		If the system has a PCHW Loop Flowmeter and SCHW Loop Flowmeter, then do the following:	0
			X		Adjust PCHWP Speed every 1 min. (adj), between Min and Max according to the following:	0
			X		While the measured SCHW Loop Flow > measured PCHW Loop Flow + 5% (adj), increase the PCHWP Speed by 7% (adj)	0
			X		While the measured SCHW Loop Flow < measured PCHW Loop Flow – 10% (adj), decrease the PCHWP Speed by 3% (adj)	0
			X		If the system does not have a PCHW Loop Flowmeter or SCHW Loop Flowmeter, then do the following:	0
			X		Adjust PCHWP Speed every 1 min. (adj), between Min and Max according to the following:	0
			X		While the Decoupler Temperature > PCHWST (before Decoupler) + 5°F (adj), increase the PCHWP Speed by 5% (adj)	0
			X		While the PCHWRT (after Decoupler) < SCHWRT (before Decoupler) – 4°F (adj), decrease the PCHWP Speed by 3% (adj)	0
				X	**Chiller Start/Stop – See Section 3.1.1A**	0
					END OF DETAILED SEQUENCE	

3.1.2B – CHW PLANT TYPE 2B – WC CHILLERS & PONY w/ DECOUPLED PRIMARY AND SECONDARY PUMPING

General

This section applies to the Central Chilled Water Plant System. The following general diagram is for diagrammatic purposes only and includes points that may not be applicable to or needed for every system. Exact location of applicable sensors, valves, and/or components of any kind shall be coordinated with the Owner if site-specific instruction is not provided within the Drawings and Specifications. Likewise, the sequence of operation includes instructions for components that may not be applicable to every system. However, the sequences are written so that elimination of components does not impact the sequence of operation for remaining components. Therefore, components that are not present may be treated as "Not Applicable". Note: the system may include more than three (3) chillers and/or three (3) primary pumps and/or three (3) secondary pumps in parallel, which is accounted for in the Detailed Sequence section.



Site Specific Chiller Plant State Tables

The tables below that are greyed out applies to previous projects, the remaining tables apply to the current project. Note: the table information may be changed during commissioning by the CxA and updated in this document for future reference of "as-built" conditions.

KRIMMEL INTERMEDIATE SCHOOL

State***	Lead	1st Lag	2nd Lag	Pony	Design Flow (gpm)	Minimum Flow (gpm)	Stage-UP Demand SP (gpm)*	Stage-DN Demand SP (gpm)*
0	OFF	OFF	OFF	OFF	0	0	Cool Call	N/A
P	N/A	N/A	N/A	**N/A**	N/A	N/A	N/A	N/A
1	**ON**	OFF	OFF	OFF	400	192	400(adj)**	N/A
2	**ON**	**ON**	OFF	OFF	800	384	800(adj)**	320(adj)**
3	**ON**	**ON**	**ON**	OFF	1200	576	N/A	640(adj)**

** Stage UP and Stage DN Bldg. Flow are based on Calculated Demand*

***The stage-up and stage-down values shown here are starting points and may be adjusted in the field during tuning*

****State P = Pony Chiller*

Detailed Sequence

CHW DP	Isolation Evap	Isolation Cond	VFD	Default	CHILLED WATER PLANT DECOUPLED LOOP SEQUENCE OF OPERATION	Revision History
				X	**General – See Section 3.1.1A**	0
				X	**SCHWP Start/Stop – See Section 3.1.2A**	0
			X		**SCHWP Speed - See Section 3.1.2A**	0
				X	**PCHWP Start/Stop – See Section 3.1.1A**	0
			X		**PCHWP Speed – See Section 3.1.2A**	0
	X				**Chiller Evaporator Isolation Valve – See Section 3.1.1A**	0
				X	**Chiller Start/Stop – See Section 3.1.1A**	0
		X			**Chiller Condenser Isolation Valve – See Section 3.1.1B**	0
				X	**Condenser Water Pump Start/Stop – See Section 3.1.1B**	0
			X		**Condenser Water Pump Speed – See Section 3.1.1B**	0
				X	**Cooling Tower Control – See Section 3.1.1B**	0
				X	**Cooling Tower Bypass Valve– See Section 3.1.1B**	0
				X	**Cooling Tower Isolation Valve – See Section 3.1.1B**	0
				X	**Cooling Tower Fan Start/Stop – See Section 3.1.1B**	0
				X	**Cooling Tower Fan Speed – See Section 3.1.1B**	0
					END OF DETAILED SEQUENCE	

3.2 – CENTRAL HEATING HOT WATER (HHW) PLANT SYSTEMS

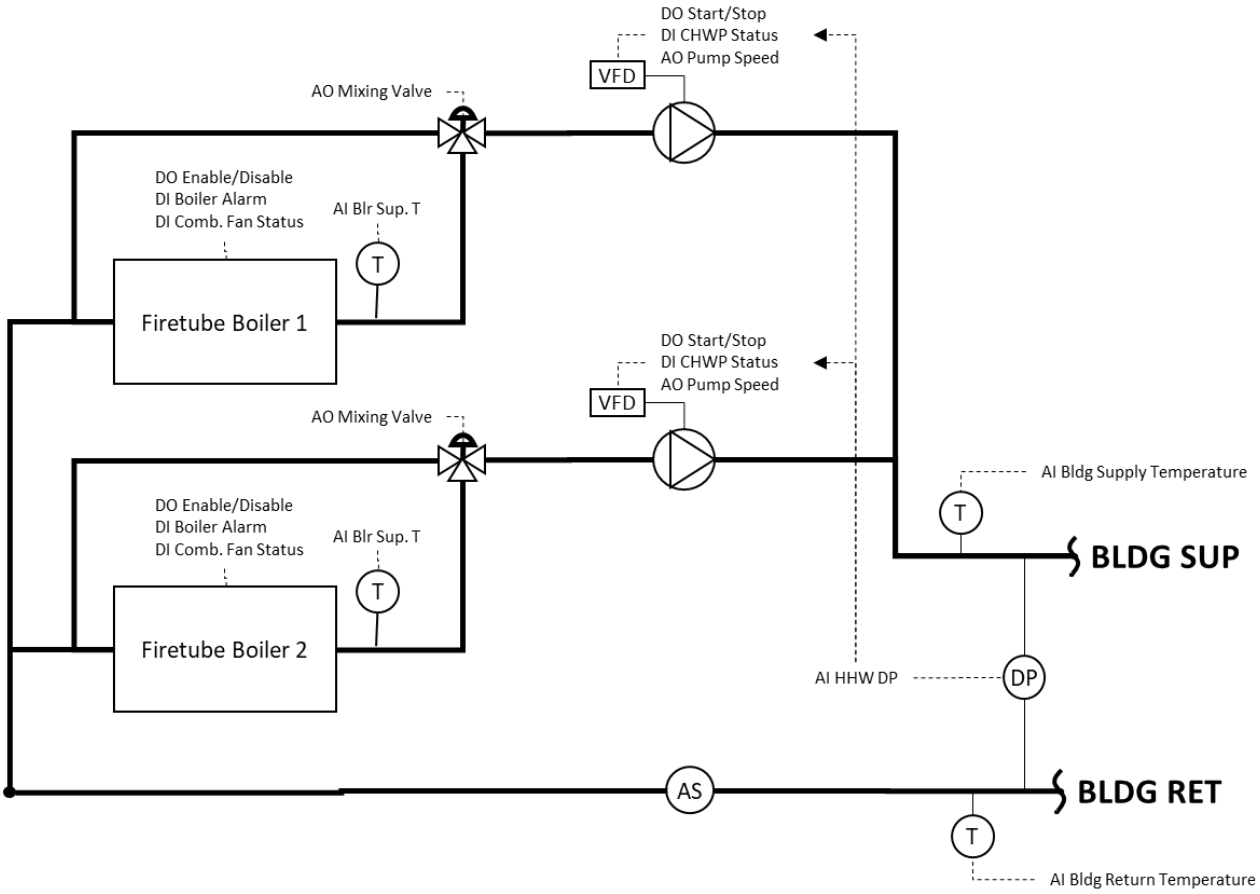
General

This section applies to the Central Heating Hot Water Plant System. The general diagrams in this section are for diagrammatic purposes only and each includes points that may not be applicable to or needed for the applicable system. Exact location of applicable sensors, valves, and/or components of any kind shall be coordinated with the Owner if site-specific instruction is not provided within the Drawings and Specifications. Likewise, the Detailed Sequence in each section includes instructions for components that may not be applicable to every system. However, the sequences are written so that elimination of components does not impact the sequence of operation for remaining components. Therefore, components that are not present may be treated as “Not Applicable”.

Heating Hot Water System Bypass Valve

Heating hot water distribution systems typically will include a combination of 3-way and 2-way valves for heating coil temperature control. In instances where the systems components consist of exclusively 2-way valves, a system bypass may be installed in the system. The valve may be installed at the plant or may be installed across the HHW supply and return pipes out in the distribution system somewhere, such as an AHU mechanical room. The purpose of the heating hot water system bypass is to avoid over-pressurizing control valves and causing valves to be “lifted” from their seats and to avoid damage to valve seat materials. This control valve may exist regardless of the boiler plant type. The setpoint for opening the valve should be set high enough so that it does not interfere with the normal operating differential pressure control. For example, if the HHWP Speed Control DP SP = between 5 psid and 20 psid, then the HHW System Bypass Valve DP SP should be much higher than 20 psid.

3.2.1 – HHW PLANT TYPE 1 – FIRETUBE BOILER(S) WITH MIXING VALVE(S)



Detailed Sequence

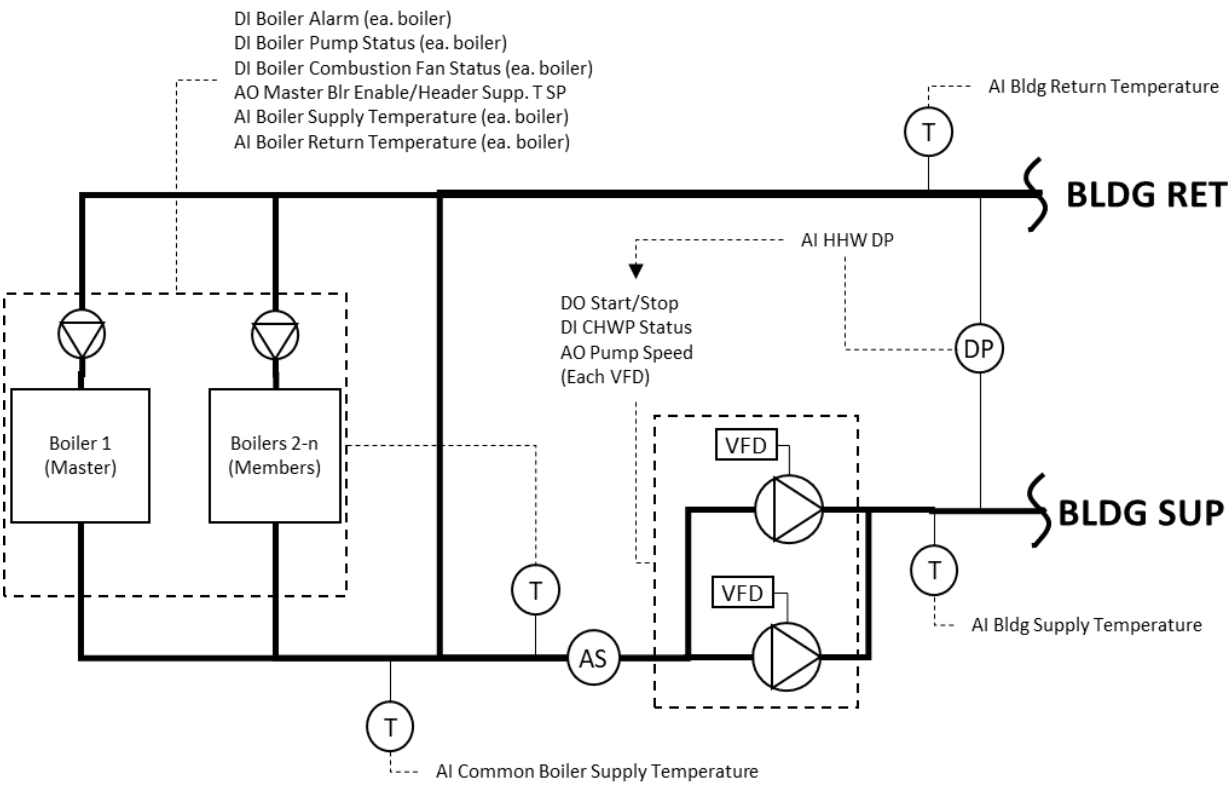
		HHW System Bypass Vavle	HHW DP	Default	Heating Hot Water Plant Type 1 – Firetube Boiler(s) with Mixing Valve(s)	Revision History
				X	**HHW Pump Start/Stop**	0
				X	Energize the lead pump whenever ANY of the following are TRUE	0
				X	Heat Requests > 0 (adj)	0
				X	Energize the lag pump whenever ALL the following are TRUE for 5 minutes (adj)	0
				X	Lead HHW Pump = ON	0

				X	ANY of the following are True	0.2
				X	HHW DP < 80% (adj) of HHW DP Setpoint	0.2
				X	HHW Pump Speed = Max HHWP Speed	0.2
				X	De-energize the lag pump whenever ANY of the following are TRUE for 10 minutes (adj)	0
				X	Heat Requests = 0	0
				X	HHW Pump Speed = Min	0
				X	De-energize the lead pump whenever ALL the following are TRUE for 15 minutes (adj)	0
				X	Heat Requests = 0	0
				X	Boiler = Disabled	0
				X	Boiler Status = OFF	
				X	Activate a HHW Pump Fail Low Priority Alarm if HHWP Fails to start	0
				X	If Lead Pump Fails to start, then rotate lead/lag designation unless both HHW Pumps are in Alarm	0
			X		**HHW Pump Speed with HW DP**	0
			X		Min HHW DP Setpoint = 5psid (adj)	0
			X		Max HHW DP Setpoint = 10psid (adj)	0
			X		Min HHW Pump Speed = 50% (adj)	0
			X		Max HHW Pump Speed = 100% (adj)	0
			X		Modulate pump speed to maintain HHW DP at Setpoint	0
			X		Adjust HHW DP Setpoint between Min and Max as follows:	0
			X		Every 5 minute(s) (adj)	0
			X		If Controlling HHW Valve Position < 60% (adj)	0
			X		HHW DP Setpoint = HHW DP Setpoint - 1psid (adj)	0
			X		If Controlling HHW Valve Position > 80% (adj)	0
			X		HHW DP Setpoint = HHW DP Setpoint + 2psid (adj)	0
			X		If any AHU Low Limit Switch (Freeze Stat) = True then set HHW DP Setpoint = Max	0
				X	**HHW Distribution Pump Speed without HW DP**	0.2
				X	Min HHW Pump Speed = 50% (adj)	0.2
				X	Max HHW Pump Speed = 100% (adj)	0.2
				X	While system is disabled, HHW Pump Speed = Min	0.2
				X	While system is enabled, do the following:	0.2
				X	Adjust HHW Pump Speed between Min and Max as follows:	0.2
				X	Every 5 minute(s) (adj)	0.2
				X	If Controlling HHW Valve Position < 60% (adj)	0.2
				X	Decrease HHW Pump Speed by 5% (adj)	0.2
				X	If Controlling HHW Valve Position > 80% (adj)	0.2
				X	Increase HHW Pump Speed by 7% (adj)	0.2
				X	If any AHU Low Limit Switch (Freeze Stat) = True then set HHW Pump Speed = 75% (adj)	0.2
				X	**Boiler Set Enable**	**0.2**
				X	Boiler Indoor Air Temperature Lockout Setpoint = 70F (adj.)	0
				X	Average Space T = Average space T for the entire building	0

				X	*Where: Average Space T = the sum of the average space temperatures served by each AHU divided by the number of AHU's. Note: For non-single-zone units the temperature used in the average above will be the average of all zones served by that AHU.*	0
				X	Minimum Space T = Minimum space T for the entire building	0
				X	*Where: Minimum Space T = the minimum of all space temperatures. Note: For non-single-zone units the temperature used in the minimum above will be the minimum of all zones served by that AHU.*	0
				X	Controlling Min Space T = (Average Space T + (N*Minimum Space T))/(N+1)	0
				X	*N is an adjustable number that can be thought of as a minimum value weighting factor, starting Value for N = 0 in this case*	0
				X	Enable the Boiler Set whenever the following statement is TRUE: (A and B and (C1 or C2 or C3)), where:	0.2
				X	ALL of the following are True	0
				X	A - Heat Requests > 0 (adj)	0.2
				X	B - Any Bldg. HWP is ON	0
				X	AND ANY of the following are True	0
				X	C1 - Controlling Min Space T < Boiler IAT Lockout – 0.5°F (adj)	0
				X	C2 - OAT < Freeze Prevention Setpoint (39F, adj)	0
				X	C3 - HWST < 75F (adj)	0.2
				X	Disable the Boiler Set whenever the following statement is TRUE (A or B or (C1 and C2 and C3)), where:	0
				X	ANY of the following are True	0
				X	A - Heat Requests = 0 for 15 minutes (adj.)	0
				X	B - ALL HWP's are OFF	0
				X	OR ALL of the following are True	0
				X	C1 - Controlling Min Space T > Boiler IAT Lockout + 0.5°F (adj)	0
				X	C2 - OAT > Freeze Prevention Setpoint + 5F (adj)	0
				X	C3 - HWRT > Bldg HWST SP - 5F (adj)	0.2
				X	Activate a boiler Critical Priority Alarm if ANY of the following are true	0
				X	DI Boiler Alarm is true	0
				X	Boiler Enable is ON and Lead HHWP = ON and HHW Supply T < 70°F (adj.)) for 10 minutes (adj.)	0
				X	**Boiler Start/Stop**	**0.2**
				X	Start the Lead Boiler when ALL are True for 5 minutes (adj)	0.2
				X	Boiler Set = Enabled	0.2
				X	Heat Request > 0 (adj)	0.2
				X	Lead HWP Command = On	0.2
				X	Lead HWP Status = On	0.2
				X	Stop the Lead Boiler when ANY of the above conditions are False for 10 minutes (adj)	0.2
				X	Start the Lag Boiler when ALL are True for 5 minutes (adj)	0.2

				X	Boiler Set = Enabled	0.2
				X	Heat Request > 0 (adj)	0.2
				X	Lag HWP Command = On	0.2
				X	Lag HWP Status = On	0.2
				X	Stop the Lag Boiler when ANY of the above conditions are False for 10 minutes (adj)	0.2
				X	**HHW Bldg. Supply Temperature Setpoint**	0.2
				X	Min HWST SP = 110F (adj.)	0.2
				X	Max HWST SP = 160F (adj.)	0.2
				X	Set HWST SP between Min and Max according to the following reset schedule	0.2
				X	OAT HHWST SP	0.2
				X	20F (adj) Max HWST SP	0.2
				X	45F (adj) Min HWST SP	0.2
				X	*Note: For boilers with local manual setpoint thermostat only (no automatic setpoint control), make sure the boiler temperature controller is set appropriately for the above, it should be set at or higher than the Max Bldg HWST SP*	0.2
				X	**HHW Mixing Valve(s)**	0.2
				X	Min Mixing Valve Position = 10% (adj)	0.2
				X	Max Mixing Valve Position = 100% (adj)	0.2
				X	Enable the Lead Boiler Mixing Valve if ALL of the following are True	0.2
				X	Lead Boiler Start/Stop = ON	0.2
				X	Lead Boiler LWT > Min Boiler LWT	0.2
				X	Disable the Lead Boiler Mixing Valve if ANY of the above conditions are False	0.2
				X	Enable the Lag Boiler Mixing Valve if ALL of the following are True	0.2
				X	Lag Boiler Start/Stop = ON	0.2
				X	Lag Boiler LWT > Min Boiler LWT	0.2
				X	Disable the Lead Boiler Mixing Valve if ANY of the above conditions are False	0.2
				X	If Mixing Valve = Disabled then set Mixing Valve = Min Mixing Valve Position	0.2
				X	If Mixing Valve = Enabled then do the following:	0.2
				X	Modulate Enabled Mixing Valve(s) between Min HWST SP and Max HWST SP using PI Loop control to maintain Bldg. HWST at HWST SP *Note: The PI Loop output is to be applied to all Enabled Mixing Valves simultaneously as if they were acting as one.*	0.2
		X			**HHW System Bypass Valve**	0.9
		X			Min Bypass Valve Position = 0% (adj)	0.9
		X			Max Bypass Valve Position = 100% (adj)	0.9
		X			Bypass Valve DP SP = 30 psid (adj)	0.9
		X			Use proportional band control to open the HHW System Bypass Valve as follows:	0.9
		X			DP = Bypass Valve DP SP, Bypass Valve = Min Bypass Valve Position	0.9
		X			DP = Bypass Valve DP SP + 10 psid (adj), Bypass Valve = Max Bypass Valve Position	0.9
					END OF DETAILED SEQUENCE	

3.2.2 – HHW PLANT TYPE 2 – WATER TUBE ALL CONDENSING OR NON-CONDENSING BOILERS



General

This sequence is based on a "Master-Member" boiler setup with the Master boiler (usually B-1) in the lead position and configured as the Master Boiler Sequencer. The Master Boiler Sequencer (condensing boiler controller) shall be configured as follows[31].

- Min Header Setpoint = Min HHWST SP listed in the Detailed Sequences section
- Max Header Setpoint = Max HHWST SP listed in the Detailed Sequences section
- Provide hardwired enable and analog setpoint signal to the Master Boiler and set the correct mode in the Master Boiler Sequencer (for the boilers provided) to achieve control of the hot water system header temperature as described below (Note: the example below is from the ENVI™ Boiler Controller Advanced User Guide, reference the installed boiler controller documentation to achieve the same result using the applicable controls). Some boiler systems will require a binary Enable point to enable the boiler to follow the analog signal for header setpoint, some may not. Some boilers require a 4-20mA signal, see your applicable boiler documentation to determine the analog signal required.
- When configured correctly, the Master boiler will communicate with Member boiler(s) via Modbus or other communication means to correctly stage the boilers to maintain hot water

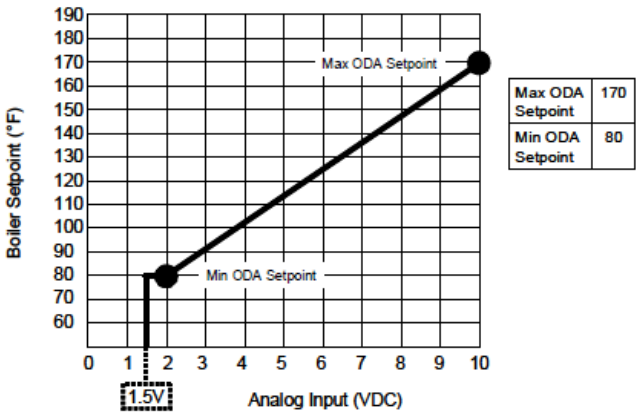
[31] Use applicable control documentation, for example see Mach® Gas-Fired Boiler C1500 & C2000 condensing boilers, Patterson-Kelly, ENVI™Boiler Controller Advanced User's Guide, p. 9, ENVI™ 09

system header temperature, according to the analog signal from the BAS to the Master boiler and the maximum and minimum temperature settings configured in the Master Boiler controller. Some systems my require some configuration of the Member boiler(s) to achieve this, please refer to your applicable boiler's control documentation to determine if further configuration is needed.

CH Mode = 7 = Analog Control of Setpoint

In this mode, an external 0-10 VDC signal controls the setpoint of the boiler. Applying a voltage of at least 1.5 VDC creates the heat request. Applying 2 VDC sets the boiler setpoint to MIN ODA SETPOINT. Applying 10 VDC sets the boiler setpoint to MAX ODA SETPOINT. Applying less than 1 VDC removes the heat request.

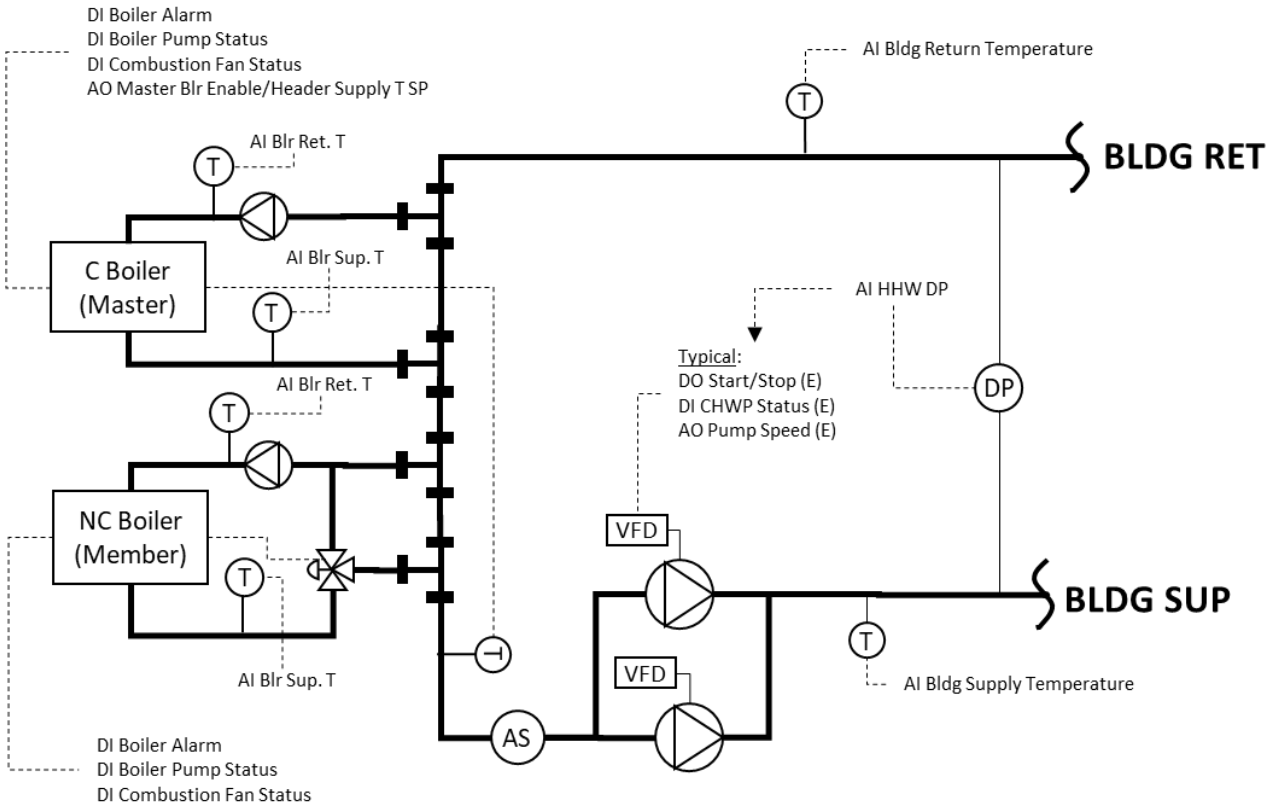
NOTICE! When in analog control mode, enable/disable terminals are non-functional.



Detailed Sequence

		HW Sys. Byp. Vlv.	HW DP	Default	Heating Hot Water Plant Type 2 – Condensing Boilers	Revision History
				X	**HHW Pump Start/Stop – See Section 3.2.1**	**0.2**
			X		**HHW Distribution Pump Speed with HW DP – See Section 3.2.1**	**0.2**
				X	**HHW Distribution Pump Speed without HW DP – See Section 3.2.1**	**0.2**
				X	**Boiler Set Enable – See Section 3.2.1**	**0.2**
				X	**HHW Bldg. Supply Temperature Setpoint – See Section 3.2.1** *Note: This is set in the Master boiler controller and must be displayed on the BMCS GUI. Master boiler controller must be configured according to the min and max analog control signal and desired Min and Max setpoint.*	**0.2**
		X			**HHW System Bypass Valve – See Section 3.2.1**	**0.9**
					END OF DETAILED SEQUENCE	

3.2.3 – HHW PLANT TYPE 3 – HYBRID CONDENSING/NON-CONDENSING BOILERS



General

This sequence is based on the following equipment installation with the condenser boiler in the lead position and configured as the Master Boiler Sequencer. The Master Boiler Sequencer (condensing boiler controller) shall be configured as follows[32].

- Min Header Setpoint = Min HHWST SP listed in the Detailed Sequences section
- Max Header Setpoint = Max HHWST SP listed in the Detailed Sequences section
- Provide hardwired enable and analog setpoint signal to the Master Boiler and set the correct mode in the Master Boiler Sequencer (for the boilers provided) to achieve control of the hot water system header temperature as described below (Note: the example below is from the ENVI™ Boiler Controller Advanced User Guide, reference the installed boiler controller documentation to achieve the same result using the applicable controls). Some boiler systems will require a binary Enable point to enable the boiler to follow the analog signal for header setpoint, some may not. Some boilers require a 4-20mA signal, see your applicable boiler documentation to determine the analog signal required.
- When configured correctly, the Master boiler will communicate with Member boiler(s) via Modbus or other communication means to correctly stage the boilers to maintain hot water system header temperature, according to the analog signal from the BAS to the Master

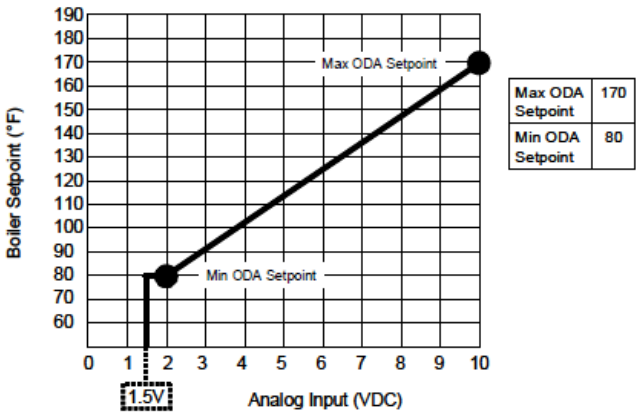
[32] Use applicable boiler controller documentation. For example see Patterson-Kelly, ENVI™Boiler Controller Advanced User's Guide, p. 9, ENVI™ 09

boiler and the maximum and minimum temperature settings configured in the Master Boiler controller. Some systems my require some configuration of the Member boiler(s) to achieve this, please refer to your applicable boiler's control documentation to determine if further configuration is needed.

CH Mode = 7 = Analog Control of Setpoint

In this mode, an external 0-10 VDC signal controls the setpoint of the boiler. Applying a voltage of at least 1.5 VDC creates the heat request. Applying 2 VDC sets the boiler setpoint to MIN ODA SETPOINT. Applying 10 VDC sets the boiler setpoint to MAX ODA SETPOINT. Applying less than 1 VDC removes the heat request.

NOTICE! When in analog control mode, enable/disable terminals are non-functional.



Detailed Sequence

		HW Sys. Byp. Vlv.	HW DP	Default	Heating Hot Water Plant Type 3 – Hybrid Condensing / Non-condensing Boilers	Revision History
				X	**HHW Pump Start/Stop – See Section 3.2.1**	**0.2**
			X		**HHW Distribution Pump Speed with HW DP – See Section 3.2.1**	**0.2**
				X	**HHW Distribution Pump Speed without HW DP – See Section 3.2.1**	**0.2**
				X	**Boiler Set Enable – See Section 3.2.1**	**0.2**
				X	**HHW Bldg. Supply Temperature Setpoint – See Section 3.2.1** *Note: This is set in the Master boiler controller and must be displayed on the BMCS GUI. Master boiler controller must be configured according to the min and max analog control signal and desired Min and Max setpoint.*	**0.2**
		X			**HHW System Bypass Valve – See Section 3.2.1**	**0.9**
					END OF DETAILED SEQUENCE	

GROUP 4 – LIGHTING CONTROL SYSTEMS

4.1 – EXTERIOR LIGHTING CONTROL

General

This section applies to any exterior lighting circuit. An exterior lighting zone may include one or more exterior lighting circuits. Exact location of applicable sensors, overrides, contactors, and/or components of any kind shall be coordinated with the Owner if site-specific instruction is not provided within the Drawings and Specifications. Likewise, the sequence of operation includes instructions for components that may not be applicable to every system. However, the sequences are written so that elimination of components does not impact the sequence of operation for remaining components. Therefore, components that are not present may be treated as "Not Applicable".

Manual Override

Override Button – Exterior lighting override shall be provided in the form of a physical momentary push-button switch located per the design drawings (or as directed by the Owner) AND in the form of a software switch accessible via the GUI as defined in the GUI specification (or as directed by the Owner).

Override Time – The physical Override Button shall be programmed to add 30 minutes (adj) per push, with a Max Override Time Limit of 2 hours (adj) total override time. Example, if someone were to press the button 3x in succession, this would result in a 1.5 hr override, if someone were to press the button 5x in succession, the resulting override timer would only accumulate to the maximum allowable time (2hrs, adj.). In no case, shall the timer be allowed to accumulate a value greater than the Max Override Time Limit described above.

Override Priority – The exterior lighting override button shall turn on all exterior lighting circuits at the single push of the button and the lights will remain on for the assigned (adjustable) duration, regardless of the condition of the sunrise/sunset astronomical time clock or the exterior lighting occupancy schedule (or stated another way, the exterior lighting override will turn on ALL exterior lighting at any time that it is utilized, 24 hours a day, 7 days a week).

Automatic Operation

Exterior lighting Zone shall turn ON when ANY of the following are true:

- ALL of the following are TRUE
  - The sunrise/sunset astronomical time clock indicates that the sun is down (based on the longitude and latitude of the facility and time-of-day)
  - The Time-of-day schedule for the exterior lighting zone is ON. *Note: "Time-of-day schedule" includes any scheduled time period regardless of the source. Example: School Dude Override Schedule constitutes a "Time-of-day schedule"*
- The exterior lighting zone override button has been activated (either on site, or via the online graphics);

Exterior lighting shall turn OFF when ALL of the following are true:

- The sunrise/sunset astronomical time clock indicates that the sun is up
- The exterior lighting override is not active (i.e. no time remains in the override countdown)

4.2 – INTERIOR LIGHTING CONTROL

General

This section applies to any interior lighting control circuit. An interior lighting zone may include one or more interior lighting circuits. Exact location of applicable sensors, overrides, contactors, and/or components of any kind shall be coordinated with the Owner if site-specific instruction is not provided within the Drawings and Specifications. Likewise, the sequence of operation includes instructions for components that may not be applicable to every system. However, the sequences are written so that elimination of components does not impact the sequence of operation for remaining components. Therefore, components that are not present may be treated as "Not Applicable".

Manual Override

Override Button – Interior lighting override shall be provided in the form of a physical momentary push-button switch located per the design drawings (or as directed by the Owner) AND in the form of a software switch accessible via the GUI as defined in the GUI specification (or as directed by the Owner).

Override Time – The physical override button shall be programmed to add 30 minutes (adj) per push, with a limit of 2 hours (adj) total override time. Example, if someone were to press the button 3x in succession, this would result in a 1.5 hour override, if someone were to press the button 5x in succession, the resulting override timer would only accumulate to the maximum allowable time (2hrs, adj.). In no case, shall the timer be allowed to accumulate a value greater than the max override time limit described above.

Override Priority – The interior lighting zone override button shall turn on all interior lighting circuits associated with that zone, at the single push of the button and the lights will remain on for the assigned (adjustable) duration, regardless of the condition of the interior photocell or the interior lighting occupancy schedule (or stated another way, the interior lighting override will turn on the associated interior lighting at any time that it is utilized, 24 hours a day, 7 days a week).

Automatic Operation

Interior lighting Zone shall turn ON when ANY of the following are true:

- ALL of the following are TRUE:
  - The Daylighting Sensor indicates that daylight is not sufficient to adequately illuminate the space. The Daylighting Sensor may be comprised of any of the following, or any combination of the following. See site-specific interior lighting control for site-specific definition.
    - Photocell mounted in the interior zone.
    - Photocell mounted outside that determines when sunlight is sufficient to illuminate the interior space via windows or skylights or both.
  - The Time-of-day schedule for the interior lighting zone is ON

- The interior lighting zone override button has been activated (either on site, or via the online graphics)

Interior lighting shall turn OFF when ALL of the following are true:

- The Daylighting Sensor indicates that daylight is sufficient to adequately illuminate the space. The Daylighting Sensor may be comprised of any of the following, or any combination of the following. See site-specific interior lighting control for site-specific definition.
    - Photocell mounted in the interior zone.
    - Photocell mounted outside that determines when sunlight is sufficient to illuminate the interior space via windows or skylights or both.
- The interior lighting override is not active (i.e., no time remains in the override countdown)

GROUP 5 – MISCELLANEOUS SYSTEMS

GENERAL

This section applies to any system not covered by Groups 1 through 4 above. A list of systems covered in this section is provided here and will be added-to as new systems are encountered that need to be controlled and/or monitored by the BMCS.

- Walk-in Coolers and Freezers
- Domestic Hot Water Systems
- Generators

5.1 – WALK-IN COOLERS AND FREEZERS

Walk-in coolers and freezers shall have a temperature sensor installed that is monitored by the BMCS.

- Critical Priority Alarm shall be generated when the temperature is more than 10°F (adj) above normal operating setpoint for 60 minutes (adj).
- High Priority Alarm shall be generated for Coolers when the measured temperature is more than 5°F (adj) below normal operating setpoint for 60 minutes (adj).
- Alarm shall require manual reset.
- Alarms shall be sent via email, text, pager, and/or any compatible device as designated by the school district personnel.
- Temperatures shall be trended on 5 min intervals and Alarms shall be trended on change of value.

5.2 – HVAC SHUTDOWN SYSTEM

The HVAC Shutdown System shall include all the following components and functionality.

- Provide a mushroom style push / pull station shutdown switch in the Administration Area or as directed by Owner / Architect.
- Issue an HVAC Shutdown Critical Priority Alarm any time the Local (on-site) or GUI (virtual) “button” is pressed/initiated.

- Signal the building automation system to de-energize the HVAC equipment.
- Stop exhaust fans and outside air units immediately.
- Other air handling units, chillers and equipment shall be shut down in an orderly manner to avoid damage to the equipment.
- Once stopped, the system may only be restarted with a key operated switch located adjacent to the shutdown switch.

5.3 – DOMESTIC HOT WATER SYSTEMS

RESERVED

5.4 – GENERATOR SYSTEMS

RESERVED

END OF SECTION

SECTION 230994 - KLEIN ISD BMCS GRAPHICS AND GUI REQUIREMENTS

Building Management Control System (BMCS), Graphical User Interface (GUI)
This section covers Klein ISD requirements for BMCS Graphics and the GUI in the following subsections:

1. **Summary of Key Updates**

2. **Purpose and Goals**

3. **General Standard Requirements**
   - a. System and Equipment Graphics
   - b. Values and Overrides in Graphics
   - c. Area Floor Plan and Area Site Plan Maps
     - *i. Coordination and Requirements for Floor Plan and Site Plan Maps*
     - *ii. Divisions of and Navigations from Floor Plan and Site Plan Maps*
     - *iii. Hard Copy Floor Plan Maps, Site Plan Maps and As-Built Drawings*
   - d. Tech/Commissioning/Tuning Pages and Information
   - e. Energy Management Features
     - *i. Scheduling*
     - *ii. Global Modify*
     - *iii. Optimum Start*
   - f. Administrative Features
     - *i. System Access and Display*
     - *ii. User Profiles*
     - *iii. User Assignments*
   - g. Reporting
   - h. Alarming
     - *i. Alarm levels and descriptions*
   - i. Trending

4. **Required Elements and Example Graphic Screenshots**
   - a. District Overview
   - b. Facility Floor Plan Overview
   - c. Lighting Floor Plan and Site Overviews
     - *i. Interior Lighting Floor Plan Overview {if applicable}*
     - *ii. Exterior Lighting Site Plan Overview*
   - d. Floor Plan Division Graphics
   - e. Area Served Overview
   - f. Cooling Plant System
   - g. Heating Plant System
   - h. AHU System
   - i. Box/Zone System
   - j. Equipment Overviews
     - *i. AHU Overviews*
       1. SZ AHU Overview
       2. VAV AHU Overview
       3. MZ AHU Overview
       4. OAHU Overview

       Space Overviews

5. VAV Box Overview
6. CV Box Overview
7. MZ Zone Overview

ii. *Humidity Sensor Overview*

iii. *Exhaust Fan Overview*

iv. *Miscellaneous Equipment Overview* (kitchen, kiln, DHW, etc.)

Summary of Key Updates

The items below are not an all-inclusive list of every addition and/or modification of this specification section since the last update; however, key items that the design team would like to draw your attention to are listed here (note: Contractors will be responsible for fulfilling and delivering all of the work included in the Project Documents [Issued Specifications, Drawings, and all Addenda] for this and every other section in the Project Documents):

1. Updated graphic screenshots were added for most sections
2. Purpose and Goals - introductory information added at the beginning of this section
3. General Standard Requirements – clarification added pertaining to advance coordination with Owner and other updates
4. Alarming (under General Standard Requirements) – updated throughout to properly correspond with BMCS Points Lists section of the Specification (23 09 34)

Purpose and Goals

Thank you!!! Klein ISD is extremely grateful for the diligent work of every member of the BMCS Teams (including: consulting engineers, commissioning engineers, account managers, project managers, installers, programmers, graphics designers, trainers, project accountants, project administrators, mechanical sub-contractors and electrical sub-contractors), it truly takes every member of the team to bring these projects together in order to provide the KISD BMCS and HVAC teams with the tools needed to serve the students, teachers, staff and community of Klein ISD.

Please let the KISD M&O Engineering and Commissioning Department know what we may do to assist and serve you and your teams in this extensive and important effort.

For Klein ISD, the BMCS GUI provides a remote view into the HVAC, mechanical and lighting systems of each facility in the District (currently about 90) to aid in the following:

- Verifying/adjusting system/equipment statuses (including: Adjusting/calibrating/tuning the operation of HVAC systems)
- Evaluating/confirming system operation/performance
- Troubleshooting/diagnosing system problems
- Energy Efficient Operation and Optimization

* *Note*: because of the large quantity of distributed facilities, varying system types, control points, and system users in Klein ISD, each vendor shall train KISD employee to become VETEran users of the systems that they install in order to accomplish the above items in serving the students and staff of the District.

The BMCS GUIs are the eyes in the sky that help KISD employees most effectively manage facility systems, both remotely and on-site. As such, the information, graphics and items in the BMCS GUI must accurately and correctly match and reflect the actual space/equipment/field conditions.

General Standard Requirements

All contractors shall provide a completely functioning Graphical User Interface upon acceptance (note: the completed GUI shall be fully programmed and implemented to the standards as defined within this document {in its entirety} and in any subsequent addendums, without any additional work by Klein ISD).

All graphics shall reside on the main system front-end server; graphics shall not be stored on individual or local controllers.
High Priority items include:

- Consistent and correctly connected graphics throughout the entire system
- Proper and correct summary pages
- Consistent labeling and naming, including Room numbers/names)
- Linking with all current Klein ISD scheduling assistant software(s)

Graphic pages shall be provided for all systems controlled and/or monitored by the BMCS. ALL graphics and GUI systems/tools shall be discussed and coordinated in advance with the Owner (please take this step of coordination very seriously, so that work may be done correctly the first time {and only once}; failure to do so may result in initial owner non-acceptance and requirement by the contractor to redo them). A concerted effort has been made to provide complete details for each specific graphic (including floor plan, summary pages, individual equipment, etc.) If there are specific pieces of equipment or systems for which graphics are not detailed in this specification, then the BMCS contractor shall coordinate with the owner before finalizing.

Items under current consideration for addition to future specifications include (note: these are not included in this current specification; however, these are already available in some existing BMCS; the list below is in a draft form of priority order).

- Timed override with tracked notes for all points with override capability
- GUI search tool (with the ability to find GUI links to equipment, specific rooms, etc. from search results)
- Event mode(s) for large areas
- Optimum Stop
- Real-time playback trending for all graphics

System and Equipment Graphics

All System and Equipment Graphics shall accurately and correctly represent the orientation of conditions in the field (example #1 – for heating coils in the reheat position in the field, the AHU graphic shall display the heating coil in the reheat position; example #2 – for dedicated chilled water pumping in the field with isolation valves on the discharge side of the chiller, the chiller plant graphic must show the piping as dedicated with the pump and isolation valve in the same arrangement). System Graphics shall be included at a minimum for the following: a) the entire cooling plant in a single graphic (which must include all associated chillers, cooling towers, pumps, valves, sensors, etc.); and b) the entire heating plant in a single graphic (which must include all associated boilers, pumps, valves, sensors, etc.). Note: this does not preclude the addition of other graphics in these situations, in fact they may be necessary in order to show additional details (for example: there may be a separate chiller and cooling tower system graphic that is a subset of the overall cooling plant System Graphic). In all cases the connection between equipment graphics must be shown in the equipment graphic and links to each associated equipment/unit graphic shall be included (example #1 – for an OAHU that serves multiple AHUs, the AHUs served must be listed and linked from the OAHU page, and each corresponding AHU must have a link back to the OAHU; example #2 – a water cooled plant with additional individual graphics for the chillers and cooling towers must link back to the cooling plant system graphic, and the latter must link back to each of the former).

Values and Overrides in Graphics

All analog values, unless the value is always an integer value {for example # of cooling requests}, shall be displayed to the tenths place, with corresponding units (for example: 55.3 ºF, 75.3 %, etc.).

Additionally, all values for display and override capability **shall conform to the following standard**: 0.0 % for fully closed or off, and 100.0 % for fully open or at full speed, as well as directly proportional for all values in between (any and all calculations, or conversions to account for direct acting vs. reversing acting, 2.0 volt to 10.0 volt, or any other variations shall be accounted for in the background such that the displayed value follows the above defined standard; example #1: a VFD set with a local minimum and maximum of 20.0 Hz and 60.0 Hz, respectively, shall display values of 0.0 % only for off, 33.3 % for 20.0 Hz, 66.7 % for 40.0 Hz, 100.0 % for 60.0 Hz, etc.; conversely when an operator override is entered for 75.0 % speed, it shall take the VFD speed to 45.0 Hz {75.0 % x 60.0 Hz max}; example #2: a reverse acting valve in which 10.0 volts is fully closed and 2.0 volts is fully open, shall display 0.0 % for 10.0 volts, 50.0 % for 6.0 volts, 0.0 % for 2.0 volts or less, etc.; conversely when an operator override is entered for 75.0 % it shall take the output to 4.0 volts {10.0 – 75.0 % x (10.0–2.0)}) .
An overridden value, whether done graphically or at the controller level via HOAs, shall display a visible indicator (color change, arrow, hand, etc.) on the impacted point in the corresponding equipment graphic. Furthermore, the indicator shall remain until the value returns to its auto or calculated value (example #1: if a chiller rotation sequence is temporarily overridden, then this override shall be displayed on the chiller graphic as long as it is in effect; example #2: if a hot water valve is commanded to 60.0 % open, it shall display as currently overridden at that value on the corresponding airside equipment; see graphic screenshots examples in Section 3).

Area Floor Plan and Area Site Plan Maps

Coordination and Requirements for Area Floor Plan and Area Site Plan Maps

ALL Area Floor Plan and Area Site Plan Maps **shall be coordinated in advance with the KISD Project Manager** (***failure to coordinate in advance will likely result in redoing the graphics to meet District requirements***). All pre-coordinated and pre-approved Maps shall be provided, both as live and active graphic versions and hard copy versions (all maps shall be sized and oriented to display correctly on a single graphic screen and an 8.5” x 11.0” paper; additional details are included below).
The following maps will be required at a minimum:

- Area HVAC Floor Plan Maps
- Area Interior Lighting Floor Plan Maps (if applicable)
- Area Exterior Lighting Site Plan Maps

Each GUI HVAC floor plan level including the Facility Floor Plan Overview shall be an active Dynamic Color Floor Plans (DCFP) that compare actual space conditions to set points {DCFPs shall utilize a range of colors that represent cool to cold and warm to hot, and the color scheme shall be labeled on each HVAC floor plan and shall remain consistent throughout all graphic levels and across all facilities within the entire control system for the District}. All floor plan maps (at all levels) shall be to scale. At all floor plan levels the system shall be programmed to allow selection of individual HVAC Schedule Areas (and if applicable HVAC Graphic Sections). Note: at whichever floor plan graphic levels individual rooms are selectable, selecting an individual room shall display the equipment serving that room.
Each GUI Lighting Floor Plan and Site Plan map shall be dynamic in nature providing a visual indication of which lighting areas (both interior and exterior) are currently occupied/on or unoccupied/off on the map.
The maps shall include the following at a minimum

1) Facility Floor Plan Overview {*required for every facility*, for the display of ALL areas and levels of the entire facility}
2) Floor Plan Divisions via HVAC Graphics Sections {as required to meet District requirements for viewing ability, particularly with regard to room numbers}
3) Interior Lighting Floor Plan Overview {if applicable}
4) Exterior Lighting Site Plan Overview {required for every facility, unless expressly excluded, even if exterior lighting is not currently controlled by the BMCS}.

Divisions of and Navigations from Floor Plan and Site Plan Maps

Divisions of and Navigation from all Floor Plan and Site Plan Maps/Levels shall conform to the following standards; full details are included throughout this document, including graphic screenshots in Section 3.

The following Floor Plan Division options are designed to meet the District's need for expedient navigation (reduce the number of mouse clicks between pages) for all facility types (High School, Junior High, Elementary and Support/Admin.). Every Floor Plan Division may not be required for every facility type; however, they are listed here to aid in required coordination and planning:

a. Floor Level Plans (required for all projects involving multi-story facilities; denoted numerically by floor number; First Floor, Second Floor, etc.);
b. HVAC Graphic Sections (at the Owner's option based on facility layout/need; denoted alphabetically with capital letters beginning with A; Graphic Section A, Graphic Section B, etc.);
c. HVAC Schedule Areas (required for ALL facilities and all projects; denoted numerically beginning with 1; HVAC Schedule Area 1, HVAC Schedule Area 2, etc.).

Divisions for Floor Level, HVAC Graphic Sections and HVAC Schedule Areas, if utilized, shall be clearly marked, displayed, and individually selectable from previous corresponding pages and via floor plan keys (example #1: if a facility has two Floor Levels then each floor level shall be marked, displayed and each floor individually selectable from the Facility Floor Plan Overview and via a corresponding floor level keys on each floor level graphic; example #2: if a facility or floor level of a facility is divided into multiple HVAC Graphic Sections, then each section shall be individually selectable from the level in which the sections are marked and via a corresponding graphic section key. In all cases divisions shall be made with regard to sections/areas served by entire HVAC systems (for example: all zones of a MZ AHU shall be contained within the same HVAC Schedule Area, and entire HVAC Schedule Areas shall be contained within HVAC graphic sections). HVAC Schedule Areas shall be clearly marked, displayed and individually selectable from the appropriate level.

Large/Common Area spaces shall be labeled on ALL floor plan levels, including the Facility Floor Plan Overview, even if room numbers are not displayed at this level. At a minimum the following spaces shall be labeled, if applicable; however, KISD reserves the right to designate other additional areas for display at its discretion: Admin., Cafeteria, Kitchen, Gym, LGI, Auditorium, Commons etc.). Navigation directly to the airside equipment serving large labeled areas shall be available at ALL Floor Plan levels, including the Facility Floor Plan Overview.

Room Number level for display **shall be coordinated in advance with the KISD Project Manager** to ensure that room numbers are displayed at the lowest possible floor plan graphic level (***failure to coordinate in advance will likely result in redoing the graphics to meet District requirements***). Note: if it is not practical to display room numbers at the Facility Floor Plan Overview level, then the Facility Floor Plan shall be divided into the approved areas in order to display room numbers. Navigation directly to the airside equipment serving numbered rooms shall be available at a minimum from all Floor Plan levels in which room numbers are labeled.

Interior Lighting Floor Plan, if applicable, requires the same coordination and level of detail as the Maps, Divisions and Sections described within for HVAC.

Exterior Lighting Site Plan shall be a to scale Site Plan with individually schedulable lighting areas labeled by Exterior Lighting Scheduling Section (denoted alphabetically with capital letters beginning with A) and followed by Corresponding Section Name {for example: A – Staff/Bus Pole Lights, or B – Main Entrance Canopy Lights, etc.)

Hard Copy Floor Plan Maps, Site Plan Maps and As-Built Drawings

In addition to the live and interactive GUI Floor Plan and Site Plan Maps, the complete graphic package also includes corresponding hard copy Floor Plan Maps, Site Plan Maps, and As-Built Drawings that include at a minimum the following:

Note: as indicated above ALL Maps, including hard copy versions, **shall be coordinated in advance with the KISD Project Manager** (***failure to coordinate in advance will likely result in redoing the graphics to meet District requirements***). Additionally, all maps shall be sized and oriented to display correctly on 8.5" x 11.0" size paper (any planned variations to this paper size requirement, shall be brought to the KISD Project Manager's attention in advance, and approval shall be obtained in writing before moving forward with any variations); maps may need to be displayed on multiple pages, depending on facility size, and should correspond to graphical Floor Plan divisions. All maps shall be correctly labeled in the top header, and shall include in the bottom footer the current page number out of the total number of pages.

a. Floor Plan by HVAC Schedule Area (this shall correctly match and correspond to the HVAC Schedule Areas listed in the Area Served Overview)
b. Floor Plans by individual AHU Areas Served (this includes AHUs that are not scheduled, and also breaks out AHU and FCUs that are combined into a single HVAC Schedule Area);
c. Floor Plans by individual Space Temperature Areas (this map further divides some AHUs into sub areas {for example: Box areas for VAV AHUs and Zone areas for MZ AHUs}, while SZ and FCU areas will remain the same as the AHU map; additionally space temperature and humidity sensor locations should be indicated on these maps in their corresponding areas)
d. Floor Plans by Interior Lighting Schedule Area (if applicable; this should also indicate the location of lighting contactors, overrides, and corresponding connection to controllers)
e. Floor Plans by Exterior Lighting Schedule Area (if applicable; this should also indicate the location of lighting contactors, overrides, and corresponding connection to controllers)
f. Equipment Location Maps – for items controlled or monitored by the BMCS (for all HVAC {including EF, Static Pressure/DP Sensor Locations, HVAC override button(s), etc.}, Interior Lighting Controls {contactors, override button(s), etc.}, Exterior Lighting Controls {contactors, override button(s), etc.}, and Other equipment controlled or monitored by the BMCS {kitchen hoods, kilns, etc.})
g. As-Built Drawings – A complete set of the "as installed" diagram(s) of the complete control system

Copies of these Maps and Drawings shall be: 1) provided electronically to KISD as converted (not scanned) PDF versions and uploaded to a folder or location in the front end GUI that is agreeable to KISD, and 2) provided as professional quality printed and laminated versions hung in the main mechanical room near the central plant control panel.

Tech/Commissioning/Tuning Pages and Information

All Tech/Commissioning/Tuning Pages and Information shall be coordinated in advance with the KISD Project Manager prior to final implementation (*failure to coordinate in advance will likely result in redoing these pages to meet District requirements*). The BMCS vendor shall provide Tech/Commissioning/Tuning pages throughout the system to allow for modifications by the Commissioning Engineer from the GUI to all variables designated as adjustable or required as adjustable in order to meet the sequences in this specification. At a minimum the following pages shall be provided: Dynamic Sequence Pages and Tuning Sequence Pages. Dynamic Sequence Pages shall incorporate the sequences with all key adjustable values in a single page for the following sequences at a minimum: Chiller Plant, Boiler Plant, All AHUs, All Boxes and All Zones. Tuning Sequence Pages shall incorporate all other variables needed for tuning for the same sequences, and shall include at a minimum: all PID variables/parameters, calibration offsets, Optimum Start/Stop variables, and all other variables not included on the Dynamic Sequence Page. Examples of Tech/Commissioning/Tuning Pages are included

in Section 3 (Required Elements and Example Graphic Screenshots). In addition to these GUI requirements, the BMCS vendor is also required to provide an electronically produced explanation of PID loop operation along with the PID starting values for each control point type (for example: P, I, Deadband and Bias for VAV AHU CHW valves).

Energy Management Features

BMCS vendor shall provide initial set-up and all needed training to Klein ISD personnel for Energy Management (EM) features. In addition, the vendor shall provide the Owner with a documentation/instruction manual for all EM features that includes screen shots and examples for each along with applicable training in order to utilize the features properly. At a minimum, the following EM features shall be fully set-up by the BMCS vendor in advance without any additional work by Klein ISD.
Required EM Features:

- *Scheduling* – shall be provided with time of day (TOD) scheduling from the GUI that has and supports all of the following features at a minimum:
    - Scheduling by "Area" as defined previously in this section, as well as by Entire Facility, District and User Definable/Customizable Group
    - Scheduling priority levels that include a hierarchy configuration in accordance with BACnet standards

- *Global Modify* – shall be programmed with the ability to globally modify and receive confirmation of change for the following points, at a minimum (each selectable by both individual facility and entire District):
    - Occupied Setpoint or Cooling Setpoint
    - Occupied Heating Setpoint or Occupied Offset
    - Unoccupied Setpoint of Cooling Setpoint
    - Unoccupied Heating Setpoint or Unoccupied Offset

- *Optimum Start* – shall be programmed to optimally start HVAC schedules in order to achieve target space temperature at the occupied time with all of the following features at a minimum
    - User selectable to enable or disable by individual occupied schedule (note: the default programmed value for this feature shall be disabled from initial programming through substantial completion and turnover to Klein ISD)
    - Adjustable temperature dead band to limit the operation of this feature, by individual occupied schedule
    - Adjustable times to limit the operation of this feature, by individual occupied schedule, either before or after the occupied start time as applicable
    - A "learning" technique with the user selectable option to enable, disable or limit this feature by individual occupied schedule
    - Manually adjustable rate of recovery by individual occupied schedule

Administrative Features

BMCS vendor shall provide initial set-up and all needed training to Klein ISD personnel for Administrative features. In addition, the vendor shall provide the Owner with a documentation/instruction manual for all Administrative features that includes screen shots and examples for each along with applicable training in order to utilize the features properly. At a minimum, the following Administrative features shall be fully set-up by the BMCS vendor in advance without any additional work by Klein ISD.
Required Administrative Features:

- *System Access and Display* – shall be programmed to provide system access from any internet connected device worldwide, with the following features at a minimum:
    - System shall support secure (https://) access
    - GUI software shall automatically size to fit the utilized device

- *User Profiles* – shall be set-up by the BMCS vendor in accordance with District profile standards with corresponding capabilities within the system; also adjustments to profiles must automatically flow through to all users assigned to that specific profile

- *User Assignments* – shall be set-up and activated by the BMCS vendor in accordance with the District provided user list; each individual user shall be connected with one of the District user profile groups, and UN and PW shall be connected and updated automatically via Active Directory in conjunction with District login credentials

Reporting

At a minimum, the following reports shall be fully set-up by the BMCS vendor in advance without any additional work by Klein ISD. In addition the BMCS vendor shall provide all needed training to Klein ISD personnel for proper report operation and management. These reports must be both immediately accessible from a reporting section of the GUI, and able to be set up in the GUI for automatic report generation and distribution on a time interval basis (for example: automatically generated on the 15th of each month and emailed to the several KISD personnel).

Required Reports (shall be selectable to report for both individual facility and entire District):

- Locked values
- Indoor DP Temperatures
- OA DB Temperatures
- OA DP Temperatures
- OA WB Temperatures

Alarming

All Alarming management and notifications shall be coordinated in advance with the KISD Project Manager (*failure to coordinate in advance may result in redoing alarming to meet District requirements*). BMCS vendor shall provide initial set-up of all requirements below, and be prepared to provide needed training to Klein ISD personnel for proper alarm operation and management. All noted alarms shall be manageable from an alarm section of the GUI, and all alarms shall be selectable for varying levels of remote notification as well as specific notification methods and personnel to notify by levels. If a particular piece of equipment is in alarm (for example an AHU with a fan failure alarm, or a chiller with a start failure alarm), then an alarm designation shall also display on the corresponding equipment graphic. Note: the Specification details below are separate, distinct and different from District Overview mismatch alarms (see District Overview section of the Specification for details on this item)

Alarm Levels and Descriptions Overview

1. General Notes - (each level and list of needed alarm points is described below) – all alarms shall also appear in an alarm console that is sortable by Alarm Level (as noted, so specific alarm levels will require manual acknowledgement in order to clear; i.e. they will not clear automatically); *ALL alarm notification emails should begin with the Alarm Level and Area in the Subject and description; description should also include pertinent details, including but not limited to Campus/Facility Name, corresponding reason for the problem {should go with and key off of details below}, etc. (for example: Subject: CRITICAL Chiller Plant Alarm at Bear Creek (BCE) Elementary; Description: CRITICAL Chiller Plant Alarm at Bear Creek (BCE) Elementary due to No chillers operating when plant is requested for xx minutes)*

2. Every individual alarm shall have variables, as indicated below to determine when and under what conditions and alarm is triggered and/or escalated to action. Each alarm priority level shall have an associated defined action (for example how to communicate and who to communicate to), then each individual alarm shall be assigned to specific priority levels as defined below. If the defined action for an alarm priority level is changed it shall impact all enabled alarms in that priority level group. Individual alarms shall have the capability to be assigned to and/or moved to different priority level groups by Admin Level users. Finally, all alarms shall have the ability to be disabled and/or later re-enabled by Admin Level users for both individual alarms and alarm priority level groups (if an alarm or alarm priority level group is disabled, then all alarm tracking and associated actions shall cease during the timeframe that the alarm is disabled, if the alarm is re-enabled then the associated action shall automatically resume at the priority level to which the re-enabled alarm is assigned).
3. The BMCS Vendor shall properly and fully set-up the defined alarm priority levels and specific alarms listed below. Additionally, the BMCS Vendor shall properly and fully train the District's Admin Level users how to operate all functions of the alarming system, including but not limited to the following: a) how to add new alarms; b) how to modify the alarm priority level of a specific alarm; c) how to modify the triggers associated with each individual alarm; d) how to modify the actions associated with each specified alarm level; e) how to add new alarm priority levels as needed; f) how to disable/re-enable alarm and alarm priority level groups.
    a. Critical Priority Level – this level of alarm would require someone to take action immediately and should require a manual acknowledgement in the console in order to clear (an internal process should be set up with the operations team for proper follow-up and document on these level of items); also shall generate texts and/or emails to technicians and supervisors when activated and after the alarm clears (at any time and on any day, i.e. 24/7/365) {the exact list of personnel is to be determined and may also include a phone call to police dispatch, if possible}; Operations team {the exact list of personnel is to be determined} should also receive a copy of the email when a Critical alarm is issued and cleared.
        i. HVAC Shutdown – any time either the local on-site or virtual GUI button is pressed/initiated
        ii. Chiller Plant Critical –
            1. No chillers operating when plant is requested and/or when AHUs are requesting cooling, and the condition is sustained for xx minutes (adjustable time)
            2. OR Chilled Water Building Supply Temp is greater than xx F (adjustable temp) for xx minutes after the plant has been enabled (adjustable time)
        iii. Boiler Plant Critical –
            1. No boilers operating when the heating plant is requested and/or when AHUs are requesting heating, and the condition is sustained for xx minutes (adjustable time)
            2. OR Hot Water Building Supply Temp is less than xx F (adjustable temp) for xx minutes after the plant has been enabled (adjustable time)
        iv. Walk in Freezer Critical (note: see "High" Priority Freezer below as well; there would need to be a marked difference between the Critical and High levels) – if a walk in freezer sensor remains above xx F (adjustable temp) for xxx minutes (adjustable time)
        v. Walk in Cooler Critical (note: see "High" Priority Cooler below as well; there would need to be a marked difference between the Critical and High Priority levels)

1. If a walk in cooler sensor remains above xx F (adjustable temp) for xxx minutes (adjustable time)
2. (not certain if this is necessary as a Critical Alarm, may just be High Alarm only {see below}, either way will need to get feedback from food service) - If a walk in cooler sensor remains below xx F (adjustable temp) for xxx minutes (adjustable time)

vi. Controller Communication Loss – if more than xx controllers (adjustable quantity) are not communicating for xxx minutes (adjustable time)

vii. No other items for this level at the current time

b. High Priority Level – this level of alarm would require someone to look into a problem during the current or next regular work day and therefore should only go to the Operations team via email {the exact list of personnel is to be determined} ; the Operations team would determine (via an inter-departmental process/matrix) what actions should be taken for each High level alarm ; also clearing of these alarms in the alarm console shall be by manual acknowledgement only (i.e. automatic clearing is not allowed), and the alarm email should repeat if the problem is not addressed within a certain time period {this time period shall be initially determined, and globally adjustable moving forward}

i. Chiller Plant High –
   1. Chilled Water Building Supply Temp is greater than xx F (adjustable temp) for xx minutes after the plant is enabled (adjustable time)
   2. CW Temp is less than xx F (adjustable temp) for xx minutes (adjustable time)

ii. AHU High –
   1. If AHU is “Occupied” and both of the following are True: fan status is “Off” and VFD speed is at “0%”
   2. If Local AHU Freeze Stat Trips

iii. Walk in Freezer High (note: see Critical Freezer above as well; there would need to be a marked difference between the Critical and High levels) – if a walk in freezer sensor remains above xx F (adjustable temp) for xx minutes (adjustable time)

iv. Walk in Cooler High (note: see Critical Cooler above as well; there would need to be a marked difference between the Critical and High levels)
   1. If a walk in cooler sensor remains above xx F (adjustable temp) for xx minutes (adjustable time)
   2. (not certain if this is necessary as a Critical Alarm, may just be High Alarm only {see below}, either way will need to get feedback from food service) - If a walk in cooler sensor remains below xx F (adjustable temp) for xx minutes (adjustable time)
   3) No other items for this level at the current time

c. Medium Priority Level – this level of alarm would require someone to look into a problem during the next xx (adjustable day limit) work days and therefore should only go to the Operations team via email {the exact list of personnel is to be determined}; the Operations team would determine (via an departmental process/matrix) what actions should be taken for each Medium level alarm. For this level of alarm Admin Users shall be able to define if manual acknowledgement is required if the item self corrects, or if automatic clearing by the BMCS Alarming system is allowed and the alarm email should repeat if the problem is not addressed within a certain time period {this time period shall be initially determined, and globally adjustable moving forward}

i. No specific alarms are included for this level at the current time

d. Low Priority Level –this level of alarm shall require someone to look into the problem at a much longer time frame (perhaps only on a monthly basis) ; this alarm level would definitely need to be automatically clearing in the alarm console if the problem returns to normal on its own
   i. No specific alarms are included for this level at the current time
e. No other additional alarm priority levels are needed at this time

Trending

BMCS vendor shall provide initial set-up and all needed training to Klein ISD personnel for proper trend operation and management. Trends shall be set-up for all points as noted within the specification.

Required Elements and Example Graphic Screenshots

The information in this section lists and describes the required elements in each of the primary graphic types. In addition to the graphical pages detailed within, the GUI shall also contain a navigation tree that allows for quick movement between facilities or to pages within individual facilities.

The example Graphic Screenshots included within are for illustrative purposes only and are not intended to dictate the way to achieve the desired results, in fact in some instances screenshots from different systems are included to illustrate various points as noted in the accompanying descriptions. In no instances shall the screenshots be considered as adequate detail for meeting the entire specification, even with the accompanying description and notes (in some instances items in the examples that do not meet the specification are not noted). The only portions of this section, which add to the specification is the sub-section titled *"Required Elements"*; all other pictures and notes are for informational and illustrative purposes only and do not amend the required specification in any way.

The following required banner values shall appear in the top/banner section of each and every page of the GUI :

- Facility Name (applicable to all pages except the District Overview Page)
- Outside Air Dry Bulb Temperature – displayed, with label, the local sensor value, followed by the corresponding value (in parentheses) for Klein ISD from an internet weather service {for example: OA dbT - 77.3 ºF (77.1 ºF)}
- Outside Air Dew Point Temperature – displayed, with label, the local sensor value, followed by the corresponding value (in parentheses) for Klein ISD from an internet weather service {for example: OA dpT - 54.8 ºF (55.2 ºF)}
- Outside Air Wet Bulb Temperature – displayed, with label, the local sensor value, followed by the corresponding value (in parentheses) for Klein ISD from an internet weather service {for example: OA wbT - 63.1 ºF (63.3 ºF)}

District Overview

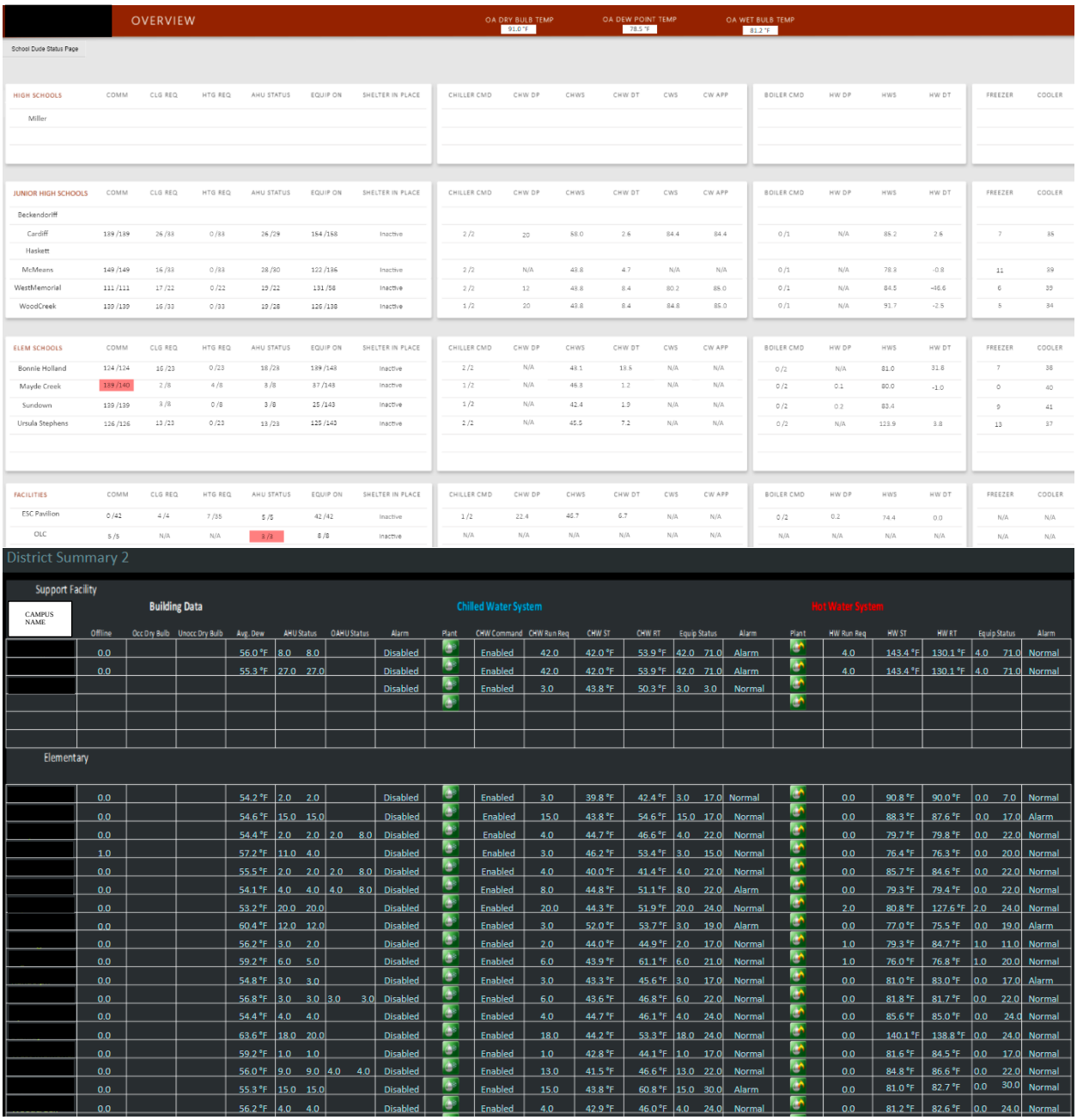
The District Overview page is intended primarily to: a) alert District HVAC operators and other employees to areas of immediate concern, and b) to provide initial information regarding the - magnitude/importance of a particular problem.

Required Elements (Specification Requirements)

1. Facility Name – with direct link to Facility Floor Plan Overview for that facility
2. Controller Communication Status – not required to display total communicating out of total controllers; however, shall indicate when controllers are not communicating and how many are not communicating at that particular facility (this point shall have an alarm indicator via color highlighting or change anytime controllers are not communicating at that particular facility)
3. Cooling and Heating Requests – values for Cooling and Heating Requests shall be displayed as current compared to total

4. AHU Status – values for AHU Status shall be based on Status per unit, and shall be displayed as current compared to total "called on/occupied" (this point shall have an alarm indicator via color highlighting or change anytime that an air unit is in alarm from a status/command mismatch at that particular facility)
5. Average Space DB Temp – value for Avg. Space DB Temp shall be the calculated average of the measured dry bulb temperature for all sensors serving spaces occupied by District personnel throughout a normal school day (i.e. not IDF/MDF, Freezer/Cooler, Plants, etc.)
6. Average Space DP Temp – value for Avg. Space DP Temp shall be the calculated average of all indoor sensors for which dew point temperature is being measured and/or calculated
7. HVAC Emergency Shutdown Status – value is binary and shall be displayed as such with the following terminology (Inactive, Disabled or Normal for the default state of not pushed, and Activated, On or Emergency for the active state when pushed)
8. Chiller and Boiler Command – values for Chiller and Boiler Command shall be based on Command per unit, and shall be displayed as current compared to total (these points shall have an alarm indicator via color highlighting or change anytime that a chiller or boiler is in alarm at that particular facility)
9. CHW DP and HW DP – values for CHW and HW DP shall be in displayed in PSI
10. CHWS and HWS Temp – values for CHWS and HWS shall be measured in the main supply from the plant to the building after any building bypasses in the plant
11. CHW and HW DT – values for CHW and HW DT shall be the delta temperature difference between the CHWS/HWS and the CHWR/HWR, the latter which shall be measured in the main return from the building to the plant before any building bypasses in the plant
12. CWS Temp (if applicable) – value for CWS temp shall be from the tower(s) to the active chiller(s)
13. CWR Temp (if applicable) – value for CWR temp shall be leaving the active chiller(s) to the tower(s)
14. CW App (if applicable) – value for CW App shall be the temperature difference between the CWS and Outdoor Wet Bulb Temperature
15. Freezer Temp
16. Cooler Temp

<u>Example and Notes below are for clarification and illustrative purposes only and in no way does this information modify the required elements detailed above or in other areas of the Specifications</u>
The screenshot examples below most closely capture the desired intent; although any/all examples may have some items in compliance with requirements and other items that are not.



Facility Floor Plan Overview

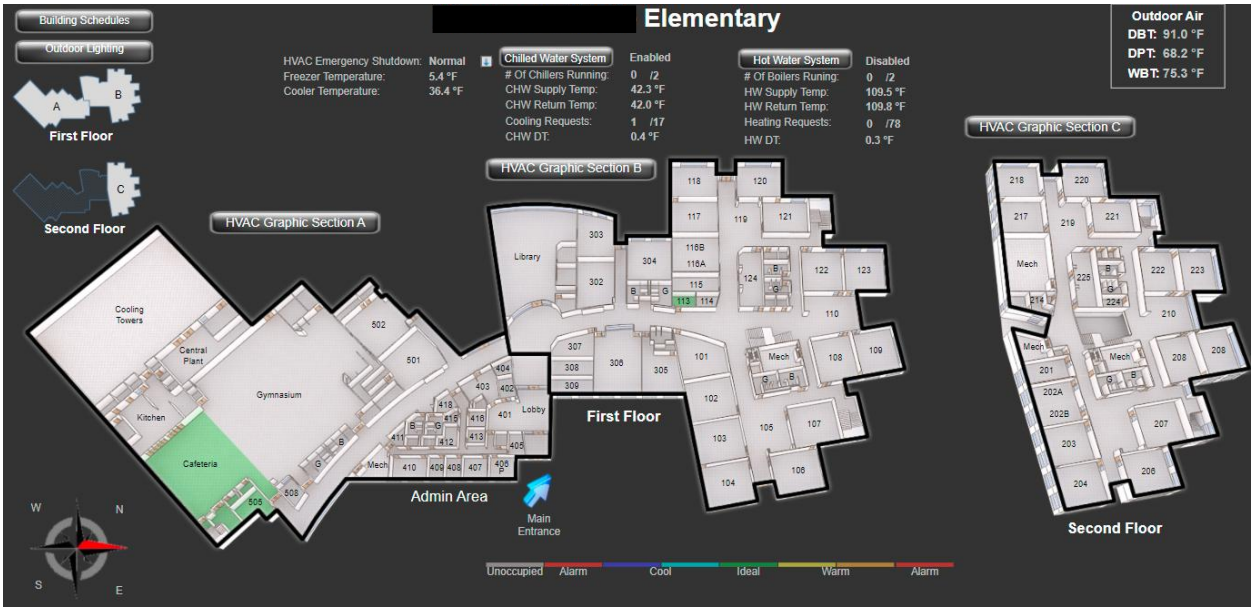
The Facility Floor Plan Overview provides a high level view of all key details for the facility, including an entire facility floor plan with the following required elements.

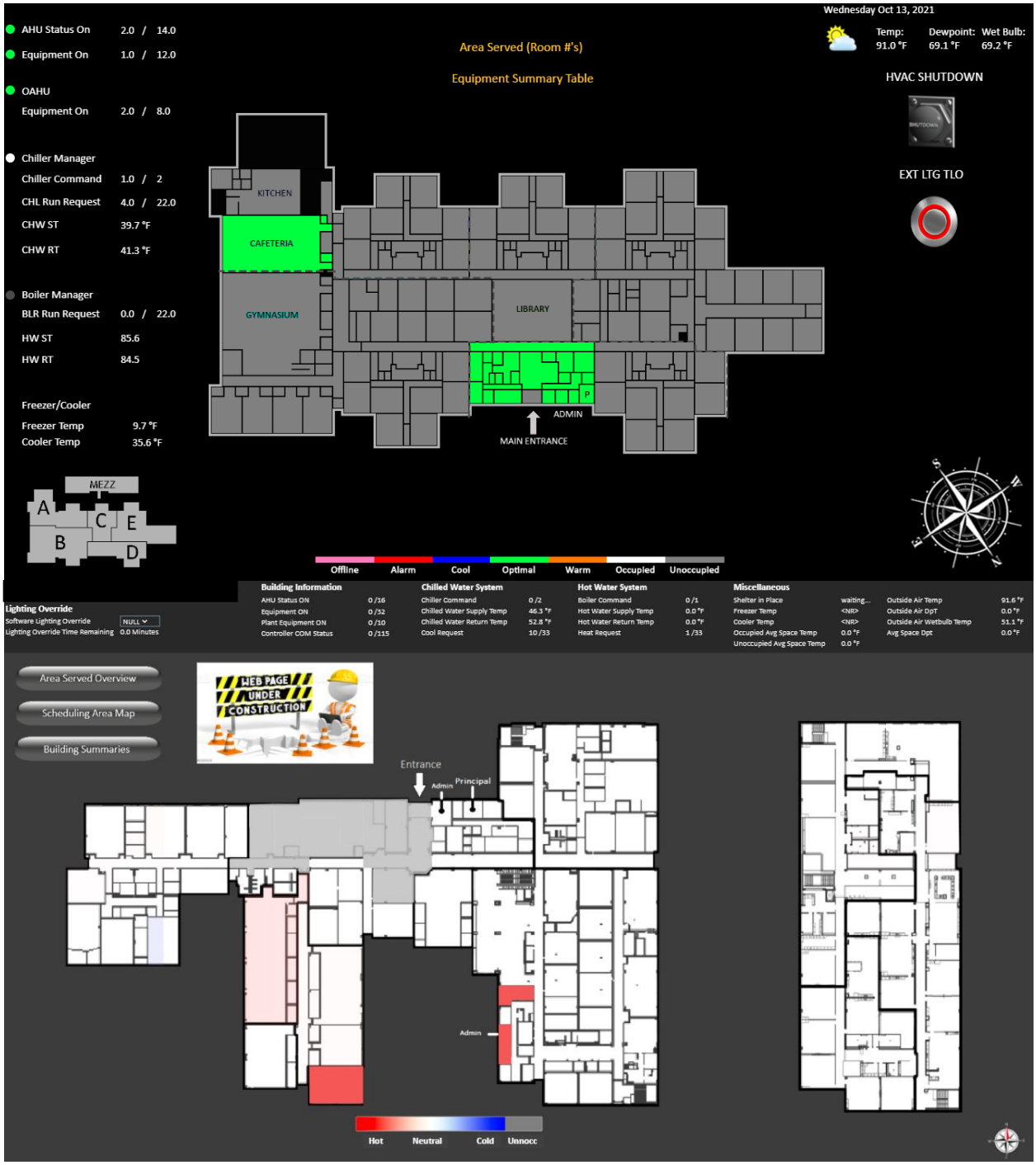
Required Elements (Specification Requirements)

1. An entire facility floor plan map with Dynamic Color Floor Plans
2. All Large/Common Areas Labeled as described within
3. A compass showing building orientation relative to true north
4. A “Main Entrance” label and arrow indicating the main entrance
5. Dynamic color changing with key/legend for all possible color values

6. Link to Area Served Overview (Room #s)
7. Link to Summary/Overview Tables (selectable list)
8. Links to Exterior and Interior Lighting Overview Maps/Pages
9. HVAC Emergency Shutdown Status – value is binary and shall be displayed as such with the following terminology (Inactive, Disabled or Normal for the default state of not pushed, and Activated, On or Emergency for the active state when pushed)
10. Cooling and Heating Requests – values for Cooling and Heating Requests shall be displayed as current compared to total
11. Chiller and Boiler Command – values for Chiller and Boiler Command shall be based on Command per unit, and shall be displayed as current compared to total (these points shall have an alarm indicator via color highlighting or change anytime that a chiller or boiler is in alarm at that particular facility)
12. CHWS and HWS Temp – values for CHWS and HWS shall be measured in the main supply from the plant to the building after any building bypasses in the plant
13. CHW and HW DT – values for CHW and HW DT shall be the delta temperature difference between the CHWS/HWS and the CHWR/HWR, the latter which shall be measured in the main return from the building to the plant before any building bypasses in the plant
14. Freezer Temp
15. Cooler Temp

<u>Example and Notes below are for clarification and illustrative purposes only and in no way does this information modify the required elements detailed above or in other areas of the Specifications</u>
The screenshot examples below most closely capture the desired intent; although any/all examples may have some items in compliance with requirements and other items that are not.





Lighting Floor Plan and Site Overview Maps/Pages

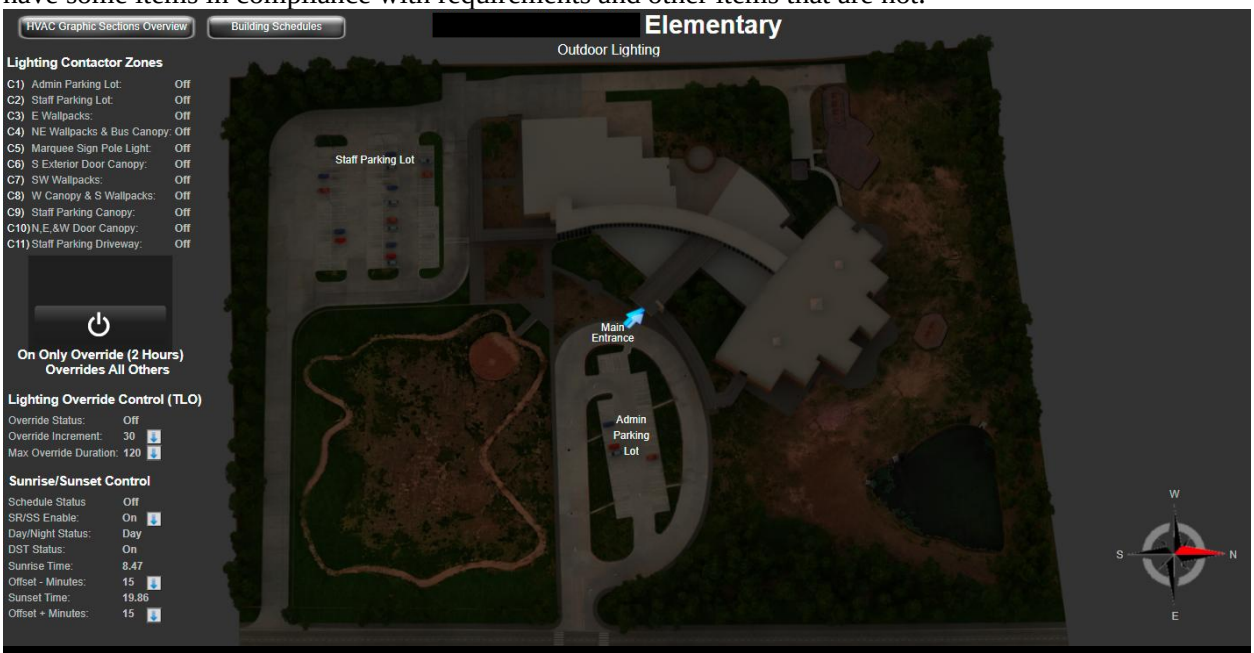
The Lighting Floor Plan and Site Overview Maps/Pages provides a high level view of all key details for lighting, including an entire facility floor plan / site plan with the following required elements.

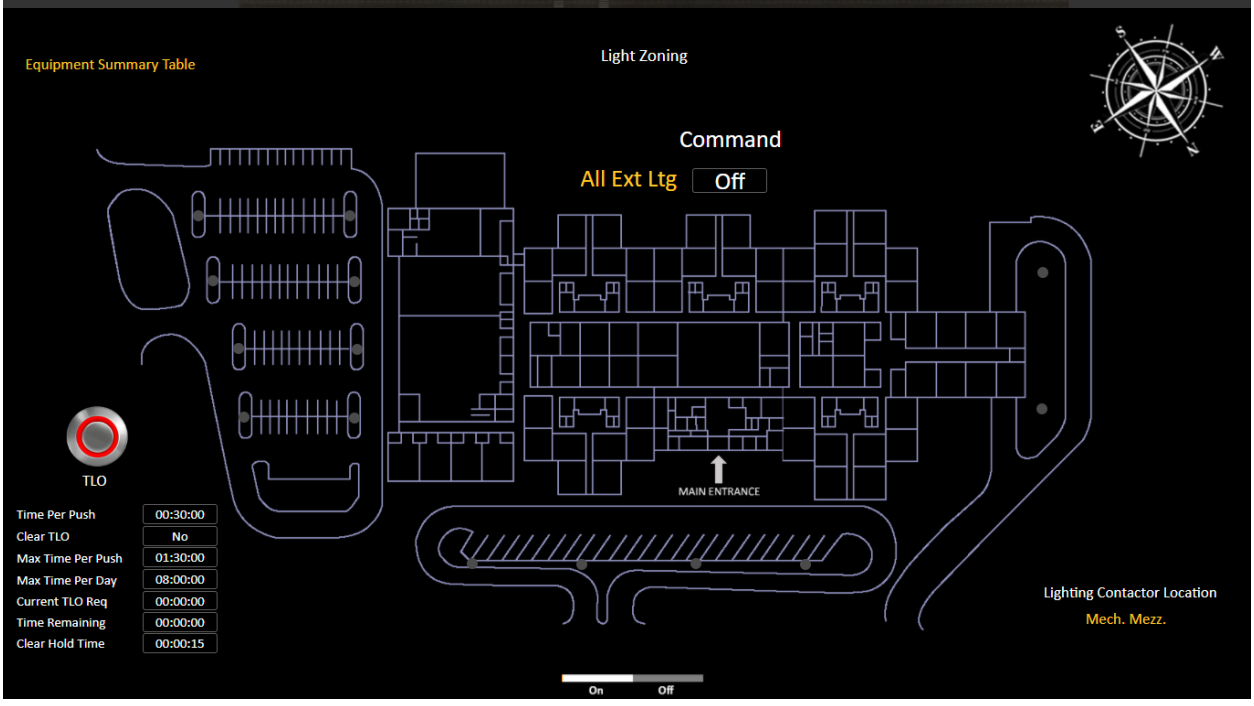
Required Elements (Specification Requirements)

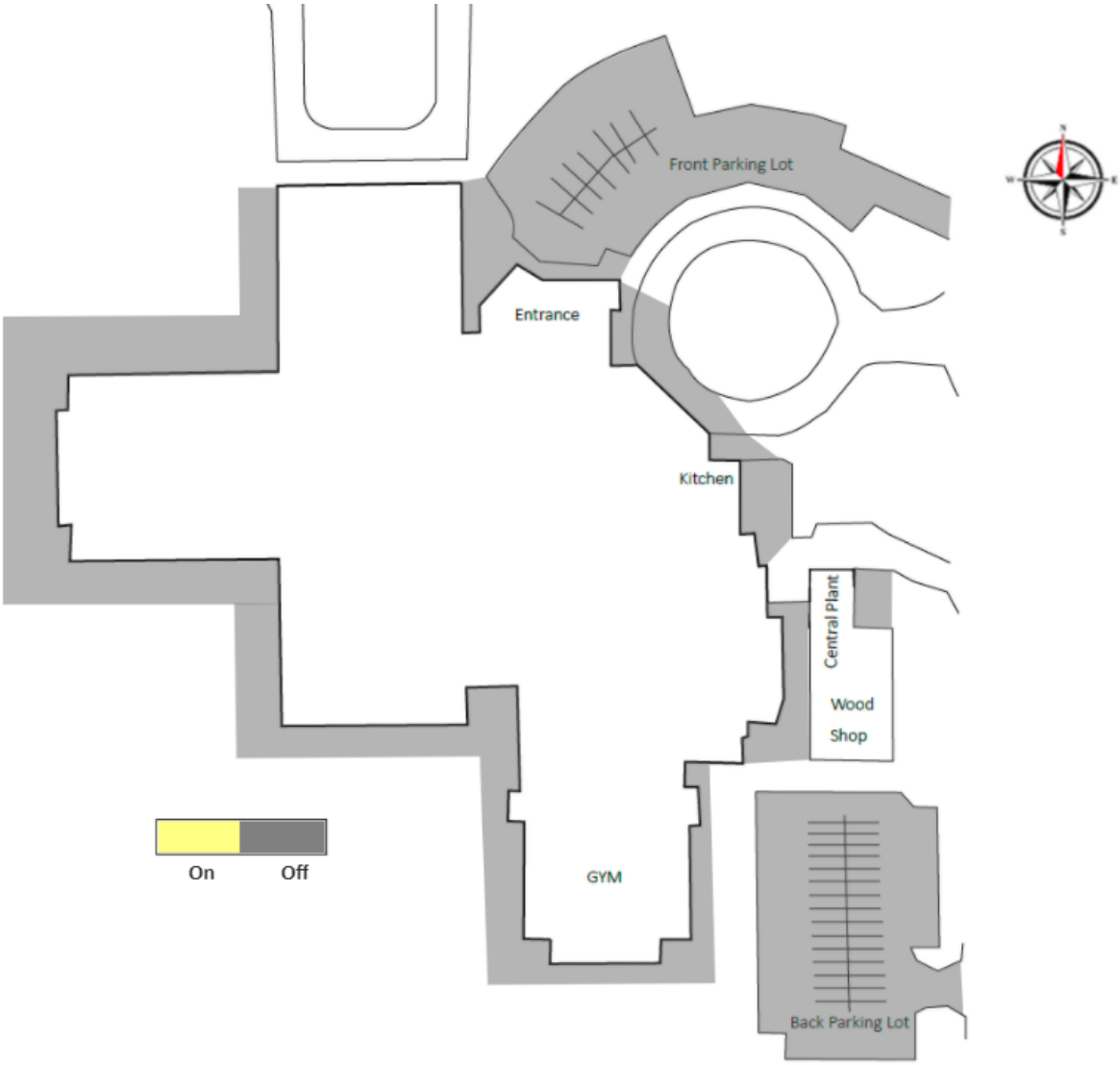
1. Facility name label
2. An entire facility floor plan or site plan map, with each controlled area prominently labeled and with Dynamic color indications of lighting occupany

3. A compass showing building orientation relative to true north
4. A "Main Entrance" label and arrow indicating the main entrance
5. Dynamic color changing with key/legend for all possible color values
6. A table with current command for each lighting area (the current command value shall be programmed for override capability with the proper level of user credentials

Example and Notes below are for clarification and illustrative purposes only and in no way does this information modify the required elements detailed above or in other areas of the Specifications
The screenshot examples below most closely capture the desired intent; although any/all examples may have some items in compliance with requirements and other items that are not.







Floor Plan Division Graphics

The Floor Plan Division Graphics provide a deeper dive into HVAC Facility Floor Plans view of all key details for lighting, including an entire facility floor plan / site plan with the following required elements.

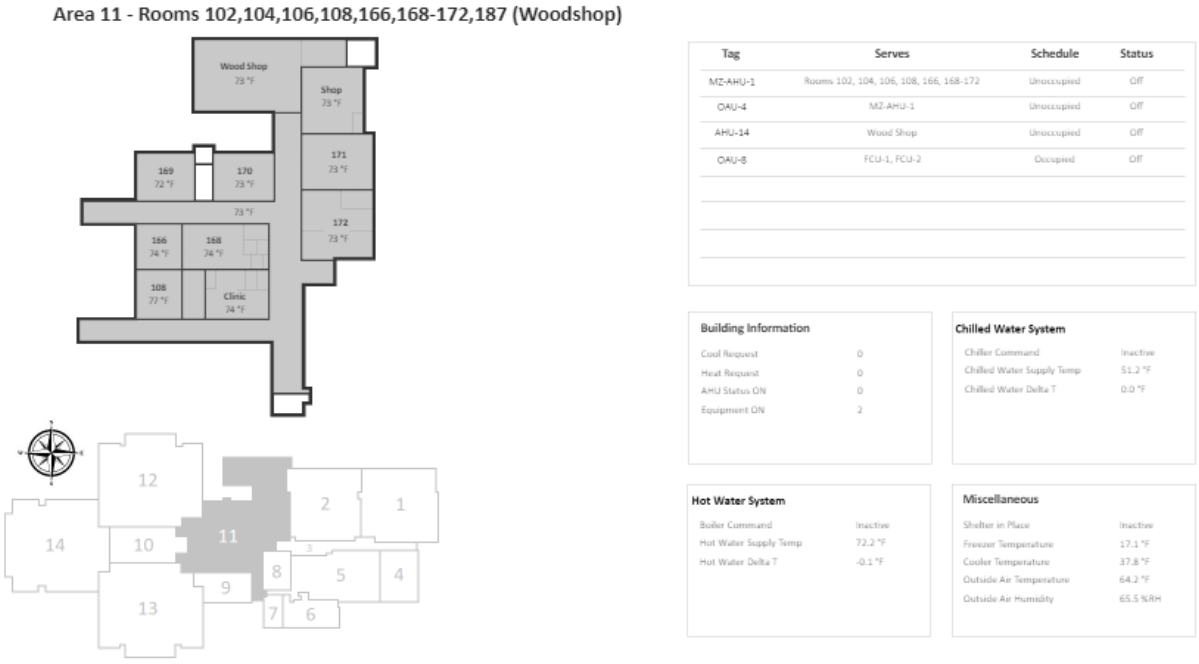
Required Elements (Specification Requirements)

1. Name of the area and description of sub areas or rooms served (for some cases and areas, this will directly correspond to the information contained in the Area Served Overview)
2. The selected portion of the facility floor plan, with each controlled area prominently labeled (may be done via a table on the same graphic)
3. Dynamic color changing with key/legend for all possible color values
4. A selectable floor plan "Area" key map to move directly between one area to another

Example and Notes below are for clarification and illustrative purposes only and in no way does this information modify the required elements detailed above or in other areas of the Specifications

The screenshot examples below most closely capture the desired intent for the Floor Plan Division Graphics. Example #1 for this section effectively demonstrates the floor plan "Area" key and connection

between units and areas served. However, some of the required items that example #1 does not include are the banner temperatures (OA dbT, OA dpT and OA wbT), and a DCFP legend/key.
Example #2 for this section effectively demonstrates the floor plan "Area" key and connection between units and areas served. However, some of the required items that example #2 does not include are the banner facility name, OA wbT, and the correct naming of Areas in place of Zones.
Example #3 for this section effectively demonstrates the floor plan "Area" key. However, some of the required items that example #3 does not include are the banner OA wbT), and connection between units and areas served.



Area Served Overview

The Area Served Overview provides a connection between HVAC Graphic Section, HVAC Schedule Areas and Areas/Rooms Served as well as units serving each Area.

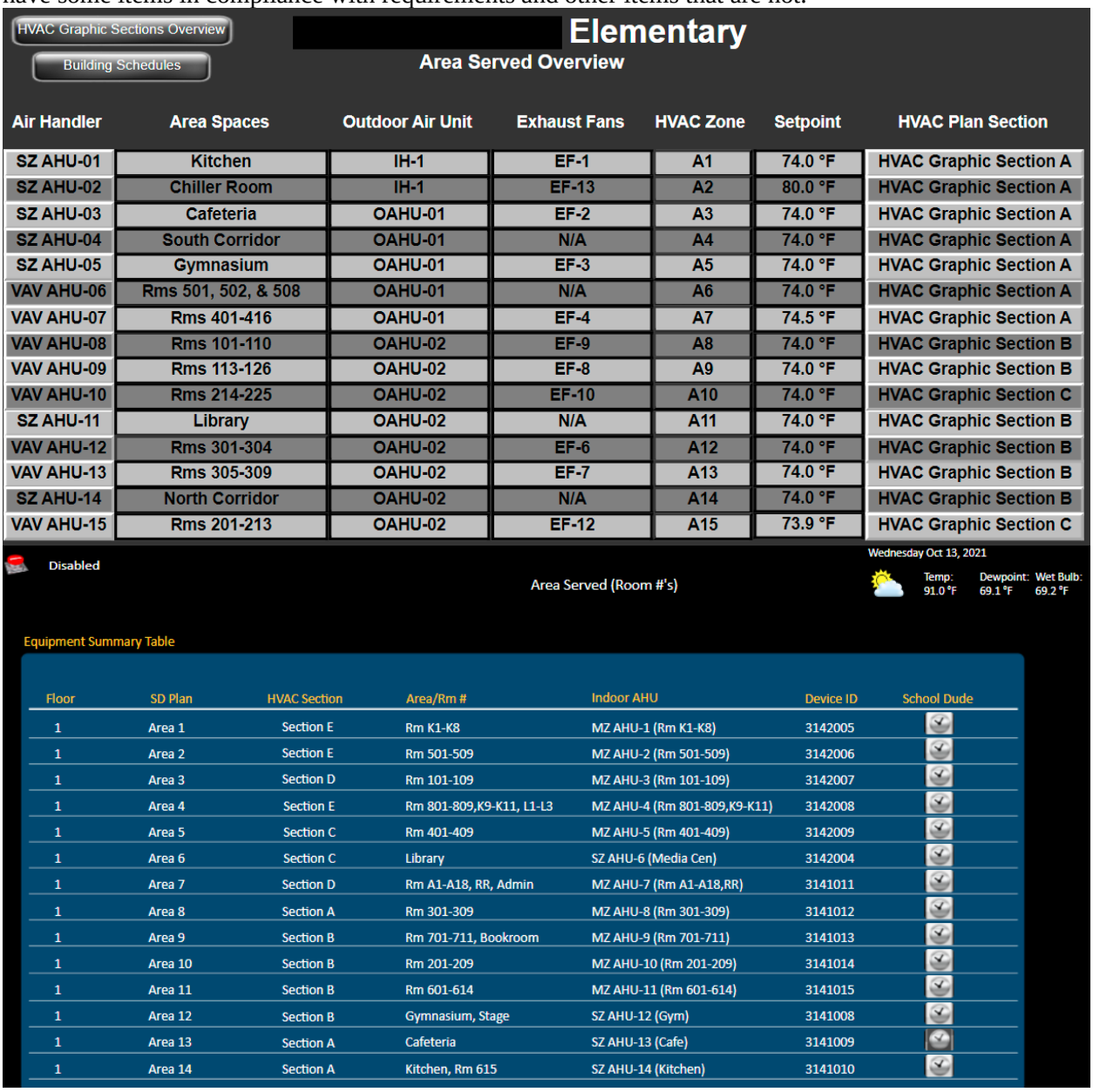
Required Elements (Specification Requirements)

1. Floor Level
2. HVAC Graphic Section (if applicable; with links directly to HVAC Graphic Section graphic)

3. HVAC Schedule Area (with links directly to HVAC Schedule Area graphic)
4. Areas/Rooms Served
5. Indoor Air Unit (with links directly to HVAC equipment graphics)

Note: If space allows, the Area Served Overview and Exhaust Fan Overview may be combined into a single sheet as long as all information from both sheets is fully displayed

Example and Notes below are for clarification and illustrative purposes only and in no way does this information modify the required elements detailed above or in other areas of the Specifications
The screenshot examples below most closely capture the desired intent; although any/all examples may have some items in compliance with requirements and other items that are not.



[redacted]

Floor	Area	Section	Area	Unit
1	Area 1	N/A	RM's A01-A17	AHU-1
1	Area 2	N/A	RM's B12-B26	AHU-2
1	Area 3	N/A	RM's B03-B08,B11,B15,B16	AHU-3
1	Area 4	N/A	Library, RM's L01A-L01F,L10	AHU-4
1	Area 5	N/A	RM's C01-C17	AHU-5
1	Area 6	N/A	Dining, Cafeteria	AHU-6
1	Area 7	N/A	Weight Room, Gymnasium	AHU-7,8
1	Area 9	N/A	Boys-Girls Locker RM's, D04A-D05D,D03A-D03C	AHU-9
1	Area 10	N/A	Band, RM's E01-E09	AHU-10
1	Area 11	N/A	RM's G01-G13, Rec,Vest	AHU-11
1	Area 12	N/A	Kitchen	AHU-12
1	Area 13	N/A	Competition Gym	AHU-13,14,15
1	Area 16	N/A	Central Plant, Woodshop, Cate Lab	FCU-1-5

Cooling Plant System

The Cooling Plant System page(s) provides a graphical overview of the cooling plant with the following required elements (also see notes above in the General Standard Requirements for System and Equipment Graphics).

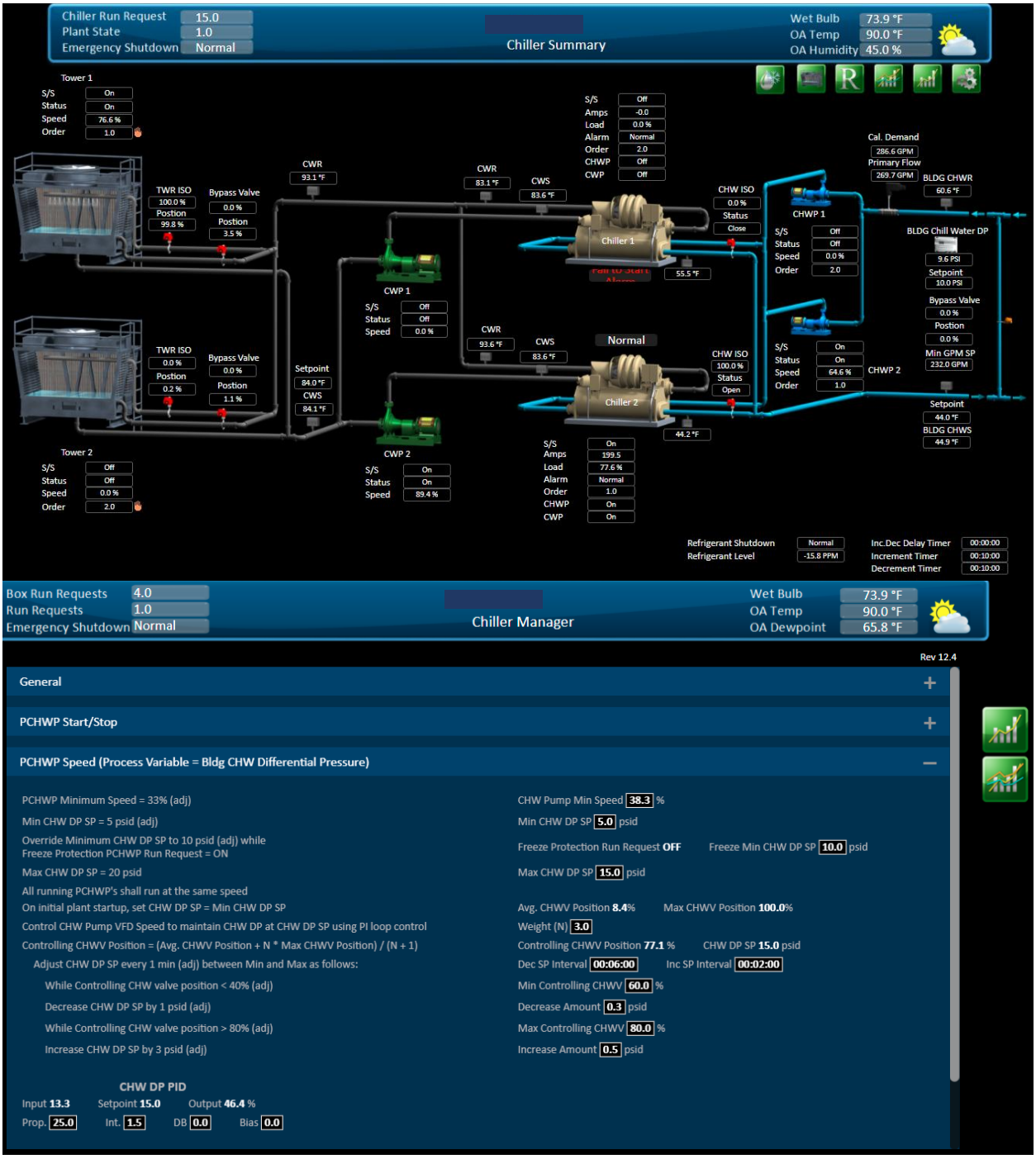
Required Elements (Specification Requirements)

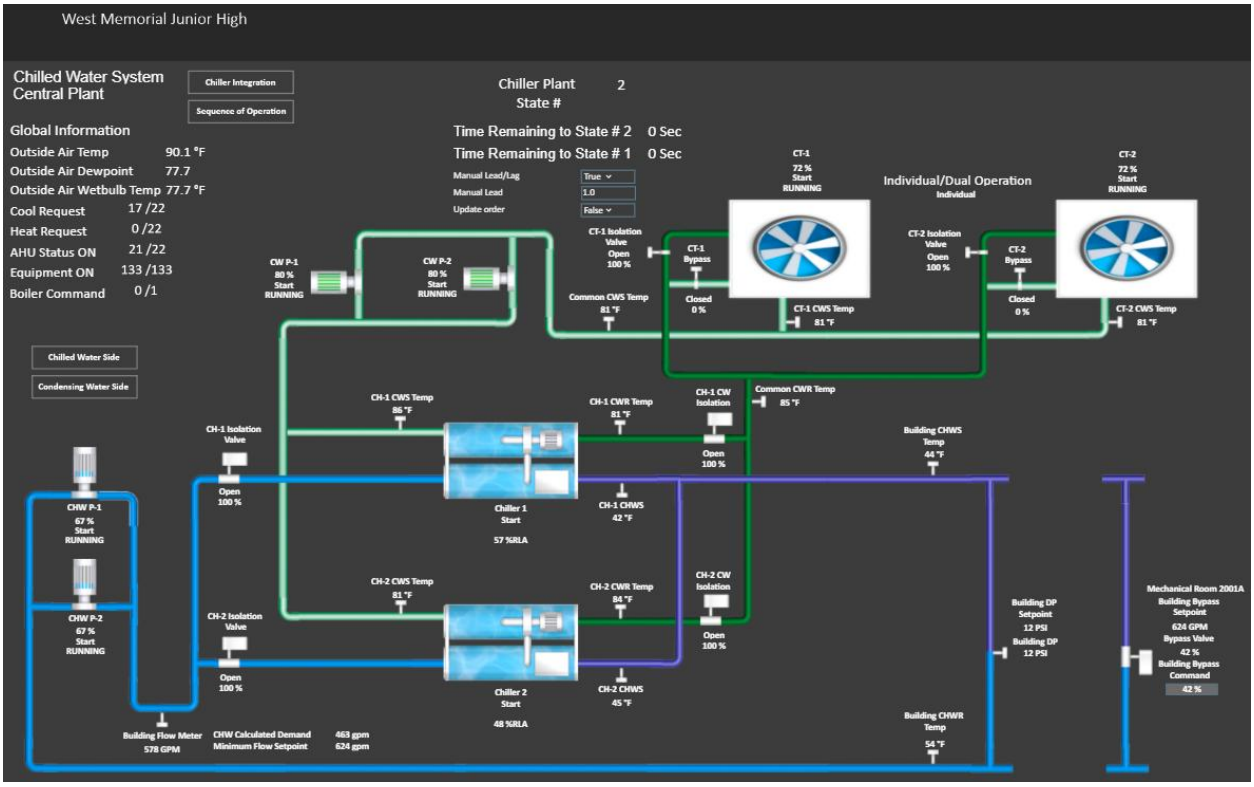
Note: due to the complex nature of Cooling Plants and the high degree of variability between cooling systems, the graphics for this system must be planned and coordinated in advance with the KISD PM.

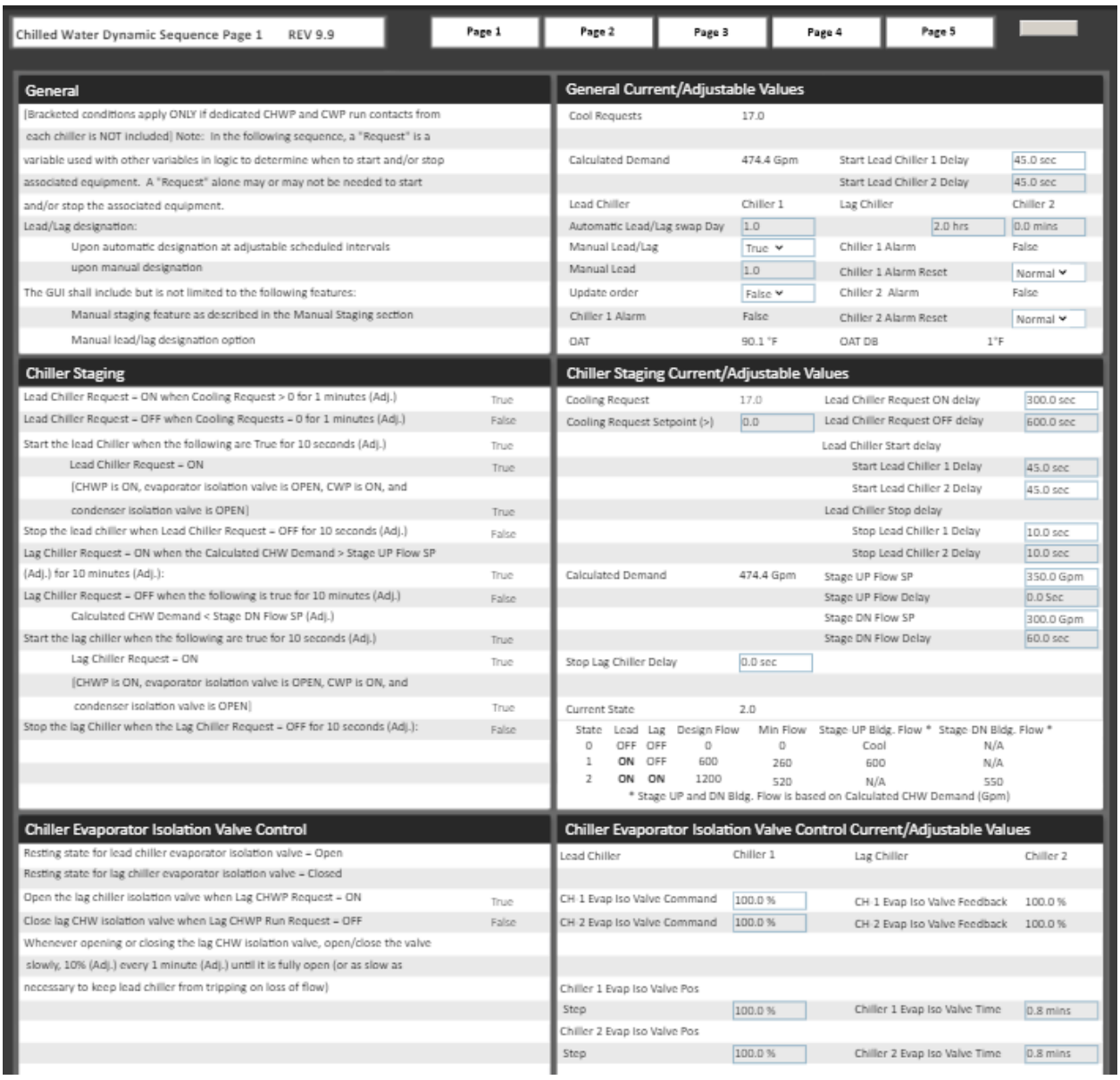
1. Current Cooling Plant State
2. Run Request Count
3. Inc./Dec. Delay Timer
4. Increment Timer
5. Decrement Timer
6. S/S Command for each chiller
7. Amps for each chiller
8. % Load for each chiller
9. Order (Lead/Lag) for each chiller
10. Plant State Table
11. CHWS Setpoint
12. CHWS and CHWR Temps (Building and CHWS for each chiller)
13. CHW DP Setpoint and Actual CHW DP
14. Calculated Flow Demand Adjacent to Actual CHW Flow
15. Link to Tech/Commissioning/Tuning Pages (ex. Sequence of Operation)
16. Chiller Integration Table and Link (if applicable)

Example and Notes below are for clarification and illustrative purposes only and in no way does this information modify the required elements detailed above or in other areas of the Specifications

The screenshot examples below most closely capture the desired intent; although any/all examples may have some items in compliance with requirements and other items that are not.


Chiller Run Request 15.0
Plant State 1.0
Emergency Shutdown Normal
Chiller Summary
Wet Bulb 73.9 °F
OA Temp 90.0 °F
OA Humidity 45.0 %
Tower 1
Tower 2
CWP 1
CWP 2
Chiller 1
Chiller 2
CHWP 1
CHWP 2
Cal. Demand 286.6 GPM
Primary Flow 269.7 GPM
BLDG CHWR 60.6 °F
BLDG Chill Water DP 9.6 PSI
Setpoint 10.0 PSI
Min GPM SP 232.0 GPM
BLDG CHWS 44.9 °F
Refrigerant Shutdown Normal
Refrigerant Level -15.8 PPM
Inc.Dec Delay Timer 00:00:00
Increment Timer 00:10:00
Decrement Timer 00:10:00
Box Run Requests 4.0
Run Requests 1.0
Emergency Shutdown Normal
Chiller Manager
Wet Bulb 73.9 °F
OA Temp 90.0 °F
OA Dewpoint 65.8 °F
Rev 12.4
General
PCHWP Start/Stop
PCHWP Speed (Process Variable = Bldg CHW Differential Pressure)
PCHWP Minimum Speed = 33% (adj)
Min CHW DP SP = 5 psid (adj)
Override Minimum CHW DP SP to 10 psid (adj) while Freeze Protection PCHWP Run Request = ON
Max CHW DP SP = 20 psid
All running PCHWP's shall run at the same speed
On initial plant startup, set CHW DP SP = Min CHW DP SP
Control CHW Pump VFD Speed to maintain CHW DP at CHW DP SP using PI loop control
Controlling CHWV Position = (Avg. CHWV Position + N * Max CHWV Position) / (N + 1)
Adjust CHW DP SP every 1 min (adj) between Min and Max as follows:
While Controlling CHW valve position < 40% (adj)
Decrease CHW DP SP by 1 psid (adj)
While Controlling CHW valve position > 80% (adj)
Increase CHW DP SP by 3 psid (adj)
CHW Pump Min Speed 38.3 %
Min CHW DP SP 5.0 psid
Freeze Protection Run Request OFF
Freeze Min CHW DP SP 10.0 psid
Max CHW DP SP 15.0 psid
Avg. CHWV Position 8.4%
Max CHWV Position 100.0%
Weight (N) 3.0
Controlling CHWV Position 77.1 %
CHW DP SP 15.0 psid
Dec SP Interval 00:06:00
Inc SP Interval 00:02:00
Min Controlling CHWV 60.0 %
Decrease Amount 0.3 psid
Max Controlling CHWV 80.0 %
Increase Amount 0.5 psid
CHW DP PID
Input 13.3 Setpoint 15.0 Output 46.4 %
Prop. 25.0 Int. 1.5 DB 0.0 Bias 0.0


West Memorial Junior High
Chilled Water System
Central Plant
Chiller Integration
Sequence of Operation
Global Information
Outside Air Temp 90.1 °F
Outside Air Dewpoint 77.7
Outside Air Wetbulb Temp 77.7 °F
Cool Request 17 /22
Heat Request 0 /22
AHU Status ON 21 /22
Equipment ON 133 /133
Boiler Command 0 /1
Chiller Plant State # 2
Time Remaining to State # 2 0 Sec
Time Remaining to State # 1 0 Sec
Manual Lead/Lag True
Manual Lead 1.0
Update order False
CT-1 72 % Start RUNNING
CT-2 72 % Start RUNNING
Individual/Dual Operation
Individual
CW P-1 80 % Start RUNNING
CW P-2 80 % Start RUNNING
CT-1 Isolation Valve Open 100 %
CT-1 Bypass
Closed 0 %
CT-2 Isolation Valve Open 100 %
CT-2 Bypass
Closed 0 %
Common CWS Temp 81 °F
CT-1 CWS Temp 81 °F
CT-2 CWS Temp 81 °F
Chilled Water Side
Condensing Water Side
CH-1 CWS Temp 86 °F
CH-1 CWR Temp 81 °F
CH-1 CW Isolation
Common CWR Temp 85 °F
CH-1 Isolation Valve
Open 100 %
Building CHWS Temp 44 °F
CHW P-1 67 % Start RUNNING
Chiller 1 Start 57 %RLA
CH-1 CHWS 42 °F
CH-2 CWS Temp 81 °F
CH-2 CWR Temp 84 °F
CH-2 CW Isolation
CHW P-2 67 % Start RUNNING
CH-2 Isolation Valve
Open 100 %
Chiller 2 Start 48 %RLA
CH-2 CHWS 45 °F
Building DP Setpoint 12 PSI
Building DP 12 PSI
Mechanical Room 2001A
Building Bypass Setpoint 624 GPM
Bypass Valve 42 %
Building Bypass Command 42 %
Building Flow Meter 578 GPM
CHW Calculated Demand 463 gpm
Minimum Flow Setpoint 624 gpm
Building CHWR Temp 54 °F



Chilled Water Dynamic Sequence Page 1 REV 9.9

Page 1 | Page 2 | Page 3 | Page 4 | Page 5

General

[Bracketed conditions apply ONLY if dedicated CHWP and CWP run contacts from each chiller is NOT included] Note: In the following sequence, a "Request" is a variable used with other variables in logic to determine when to start and/or stop associated equipment. A "Request" alone may or may not be needed to start and/or stop the associated equipment.

Lead/Lag designation:

- Upon automatic designation at adjustable scheduled intervals
- upon manual designation

The GUI shall include but is not limited to the following features:

- Manual staging feature as described in the Manual Staging section
- Manual lead/lag designation option

General Current/Adjustable Values

Cool Requests	17.0		
Calculated Demand	474.4 Gpm	Start Lead Chiller 1 Delay	45.0 sec
		Start Lead Chiller 2 Delay	45.0 sec
Lead Chiller	Chiller 1	Lag Chiller	Chiller 2
Automatic Lead/Lag swap Day	1.0	2.0 hrs	0.0 mins
Manual Lead/Lag	True	Chiller 1 Alarm	False
Manual Lead	1.0	Chiller 1 Alarm Reset	Normal
Update order	False	Chiller 2 Alarm	False
Chiller 1 Alarm	False	Chiller 2 Alarm Reset	Normal
OAT	90.1 °F	OAT DB	1°F

Chiller Staging

Lead Chiller Request – ON when Cooling Request > 0 for 1 minutes (Adj.)	True
Lead Chiller Request – OFF when Cooling Requests – 0 for 1 minutes (Adj.)	False
Start the lead Chiller when the following are True for 10 seconds (Adj.)	True
Lead Chiller Request – ON	True
(CHWP is ON, evaporator isolation valve is OPEN, CWP is ON, and condenser isolation valve is OPEN)	True
Stop the lead chiller when Lead Chiller Request – OFF for 10 seconds (Adj.)	False
Lag Chiller Request – ON when the Calculated CHW Demand > Stage UP Flow SP (Adj.) for 10 minutes (Adj.):	True
Lag Chiller Request – OFF when the following is true for 10 minutes (Adj.)	False
Calculated CHW Demand < Stage DN Flow SP (Adj.)	
Start the lag chiller when the following are true for 10 seconds (Adj.)	True
Lag Chiller Request – ON	True
(CHWP is ON, evaporator isolation valve is OPEN, CWP is ON, and condenser isolation valve is OPEN)	True
Stop the lag Chiller when the Lag Chiller Request – OFF for 10 seconds (Adj.):	False

Chiller Staging Current/Adjustable Values

Cooling Request	17.0	Lead Chiller Request ON delay	300.0 sec
Cooling Request Setpoint (>)	0.0	Lead Chiller Request OFF delay	600.0 sec
		Lead Chiller Start delay	
		Start Lead Chiller 1 Delay	45.0 sec
		Start Lead Chiller 2 Delay	45.0 sec
		Lead Chiller Stop delay	
		Stop Lead Chiller 1 Delay	10.0 sec
		Stop Lead Chiller 2 Delay	10.0 sec
Calculated Demand	474.4 Gpm	Stage UP Flow SP	350.0 Gpm
		Stage UP Flow Delay	0.0 Sec
		Stage DN Flow SP	300.0 Gpm
		Stage DN Flow Delay	60.0 sec
Stop Lag Chiller Delay	0.0 sec		
Current State	2.0		

State	Lead	Lag	Design Flow	Min Flow	Stage UP Bldg. Flow *	Stage DN Bldg. Flow *
0	OFF	OFF	0	0	Cool	N/A
1	ON	OFF	600	260	600	N/A
2	ON	ON	1200	520	N/A	550

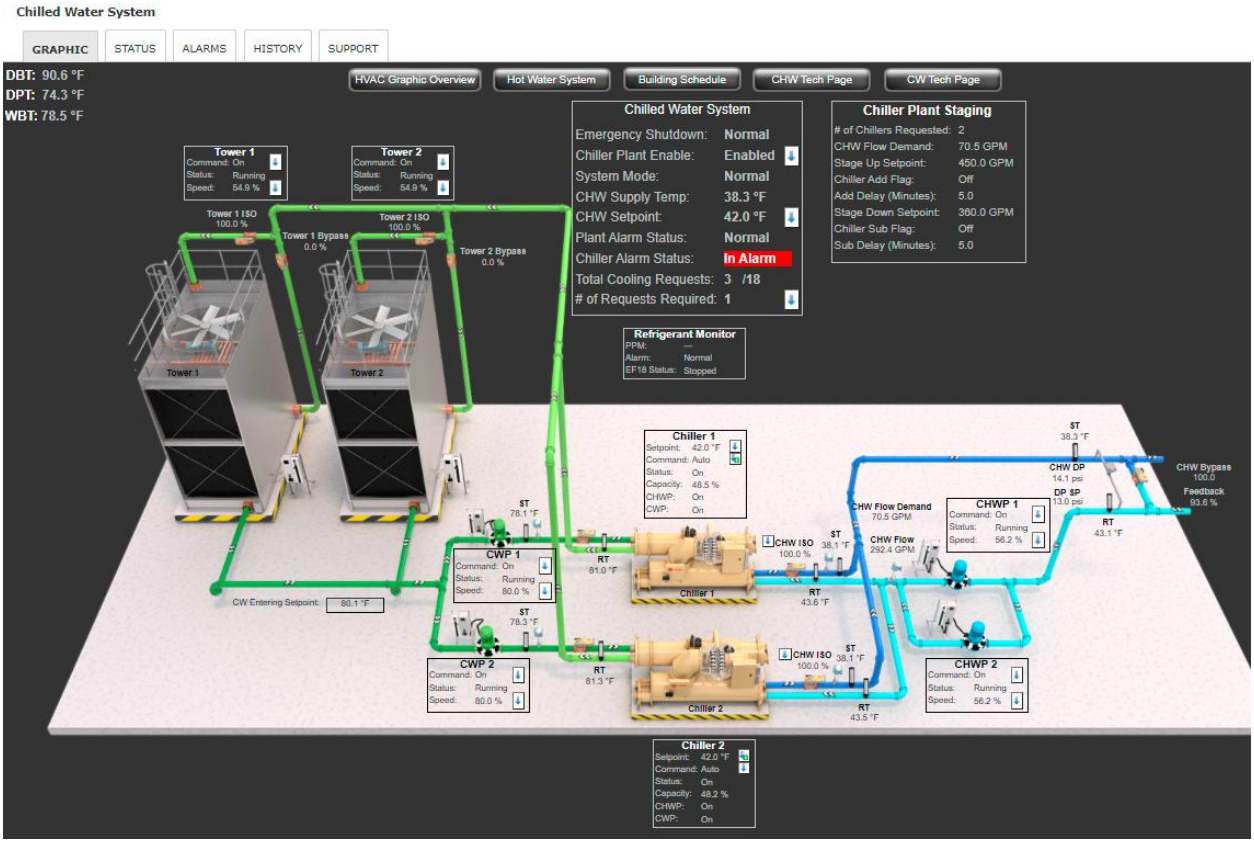
* Stage UP and DN Bldg. Flow is based on Calculated CHW Demand (Gpm)

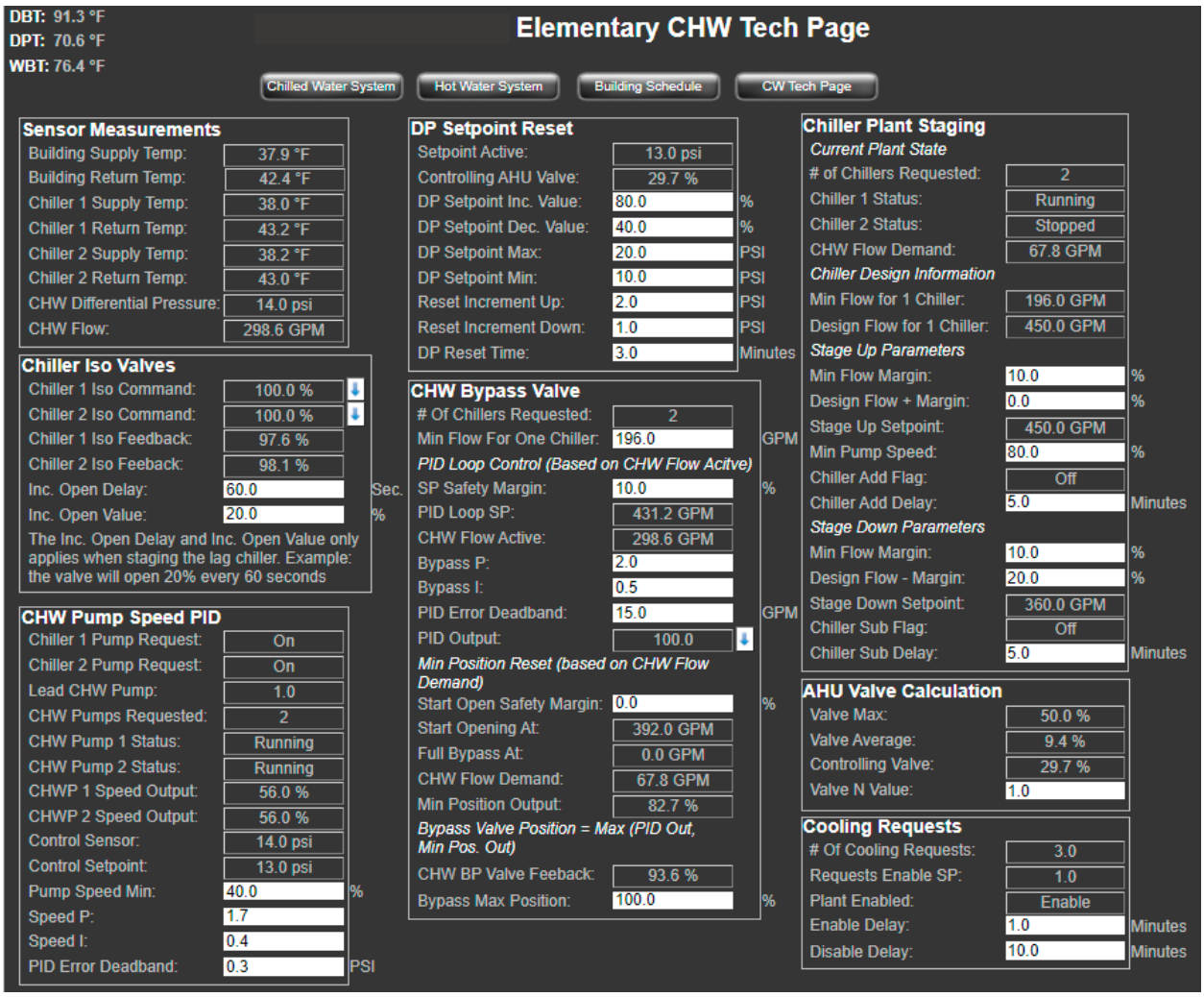
Chiller Evaporator Isolation Valve Control

Resting state for lead chiller evaporator isolation valve – Open	
Resting state for lag chiller evaporator isolation valve – Closed	
Open the lag chiller isolation valve when Lag CHWP Request – ON	True
Close lag CHW isolation valve when Lag CHWP Run Request – OFF	False
Whenever opening or closing the lag CHW isolation valve, open/close the valve slowly, 10% (Adj.) every 1 minute (Adj.) until it is fully open (or as slow as necessary to keep lead chiller from tripping on loss of flow)	

Chiller Evaporator Isolation Valve Control Current/Adjustable Values

Lead Chiller	Chiller 1	Lag Chiller	Chiller 2
CH 1 Evap Iso Valve Command	100.0 %	CH 1 Evap Iso Valve Feedback	100.0 %
CH 2 Evap Iso Valve Command	100.0 %	CH 2 Evap Iso Valve Feedback	100.0 %
Chiller 1 Evap Iso Valve Pos			
Step	100.0 %	Chiller 1 Evap Iso Valve Time	0.8 mins
Chiller 2 Evap Iso Valve Pos			
Step	100.0 %	Chiller 2 Evap Iso Valve Time	0.8 mins


Chilled Water System
GRAPHIC
STATUS
ALARMS
HISTORY
SUPPORT
DBT: 90.6 °F
DPT: 74.3 °F
WBT: 78.5 °F
HVAC Graphic Overview
Hot Water System
Building Schedule
CHW Tech Page
CW Tech Page
Chilled Water System
Emergency Shutdown: Normal
Chiller Plant Enable: Enabled
System Mode: Normal
CHW Supply Temp: 38.3 °F
CHW Setpoint: 42.0 °F
Plant Alarm Status: Normal
Chiller Alarm Status: In Alarm
Total Cooling Requests: 3 /18
# of Requests Required: 1
Chiller Plant Staging
# of Chillers Requested: 2
CHW Flow Demand: 70.5 GPM
Stage Up Setpoint: 450.0 GPM
Chiller Add Flag: Off
Add Delay (Minutes): 5.0
Stage Down Setpoint: 360.0 GPM
Chiller Sub Flag: Off
Sub Delay (Minutes): 5.0
Tower 1
Tower 2
Refrigerant Monitor
Chiller 1
Chiller 2
CWP 1
CWP 2
CHWP 1
CHWP 2
CHW Flow Demand 70.5 GPM
CHW Flow 292.4 GPM
CHW Bypass
CW Entering Setpoint: 80.1 °F



Heating Plant System

The Heating Plant System page(s) provides a graphical overview of the heating plant with the following required elements (also see notes above in the General Standard Requirements for System and Equipment Graphics).

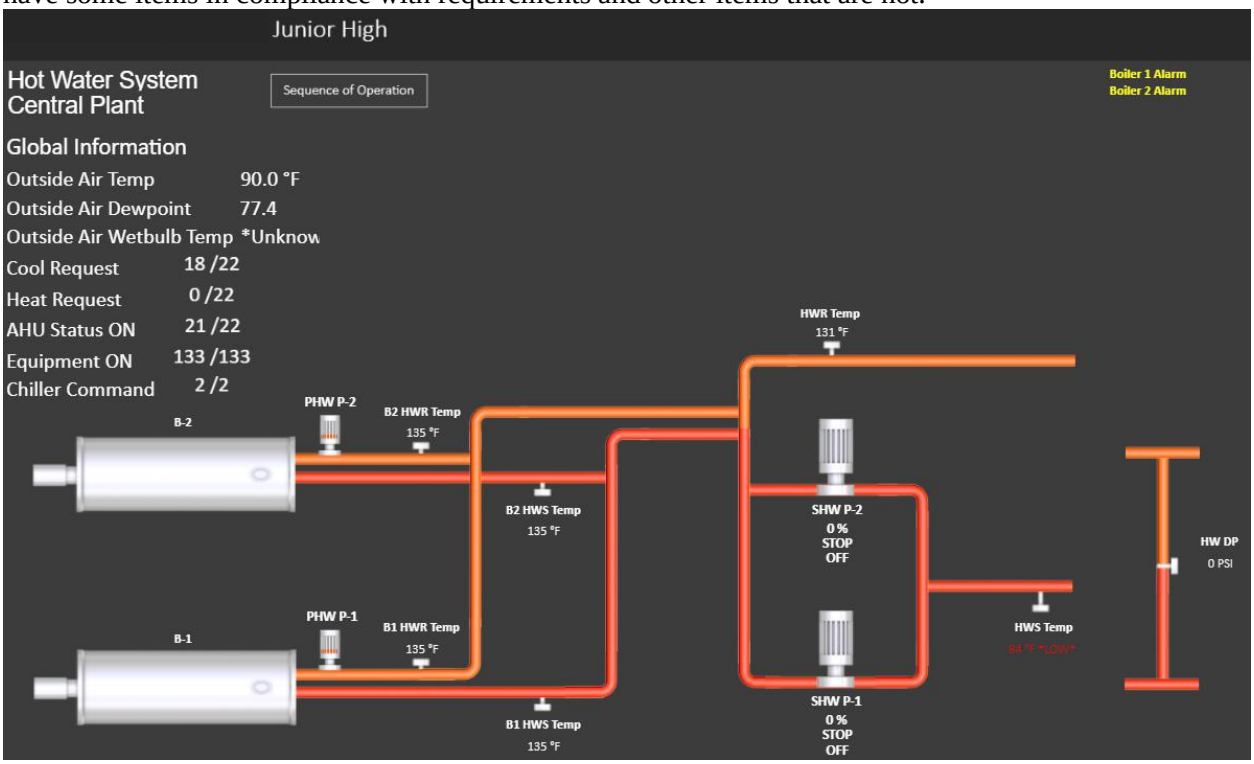
Required Elements (Specification Requirements)

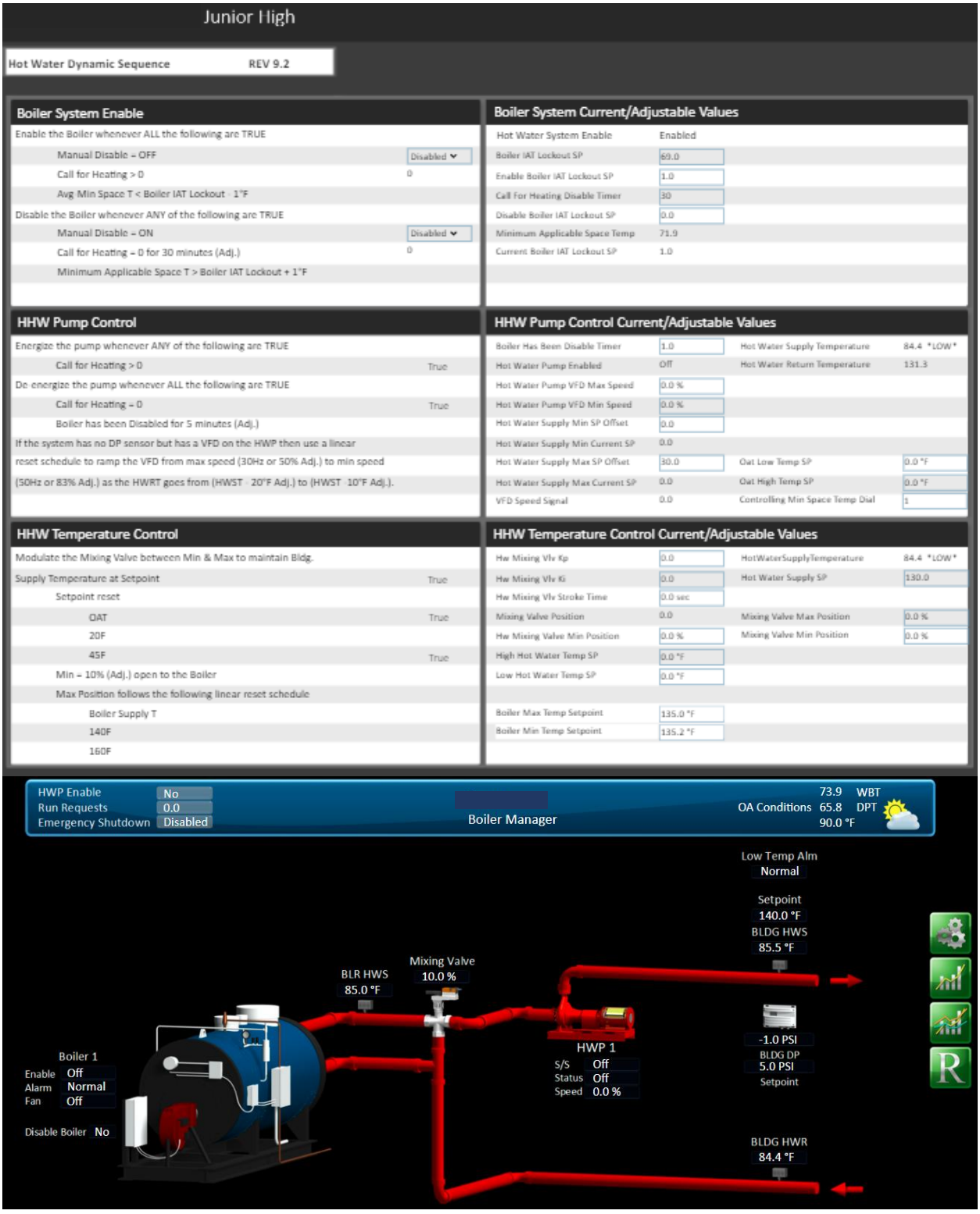
Note: due to the complex nature of Heating Plants and the high degree of variability between heating systems, the graphics for this system must be planned and coordinated in advance with the KISD PM.

1. Current Heating Plant State
2. Run Request Count
3. Boiler Enable
4. HWS Setpoint
5. HWS and HWR Temps (Building and HWS for each boiler, if applicable)
6. HW DP Setpoint and Actual HW DP
7. Links to Tech/Commissioning/Tuning Pages (ex. Sequence of Operation)

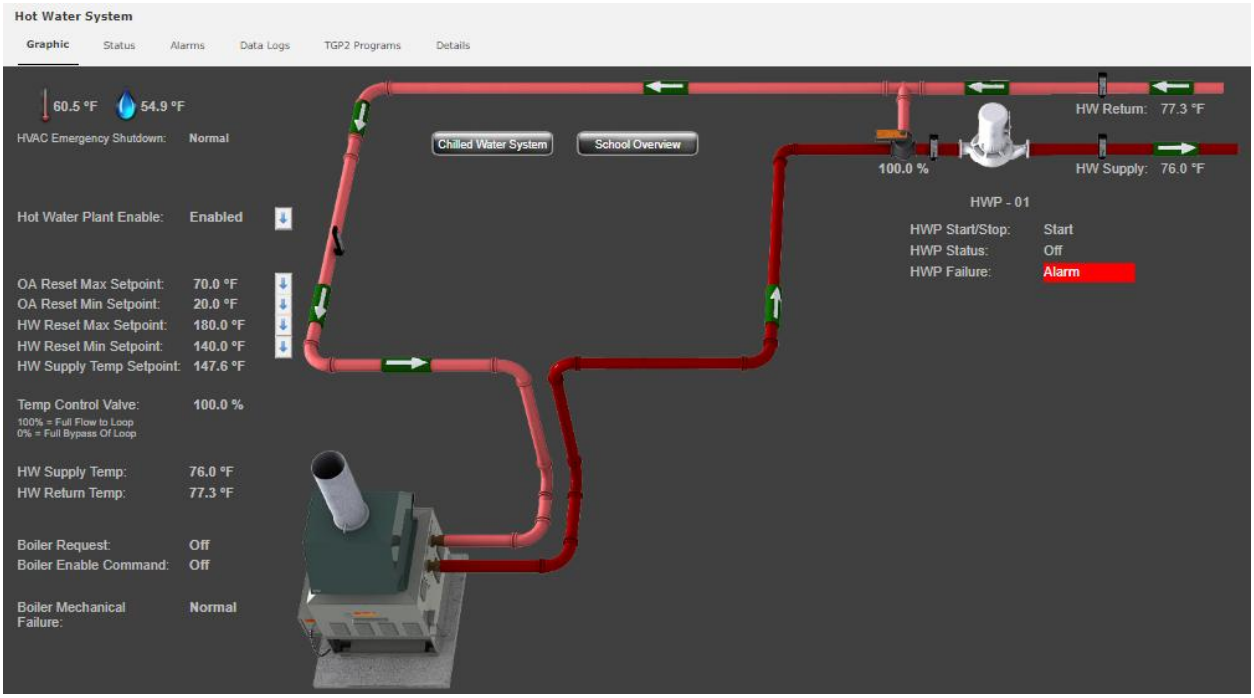
Example and Notes below are for clarification and illustrative purposes only and in no way does this information modify the required elements detailed above or in other areas of the Specifications

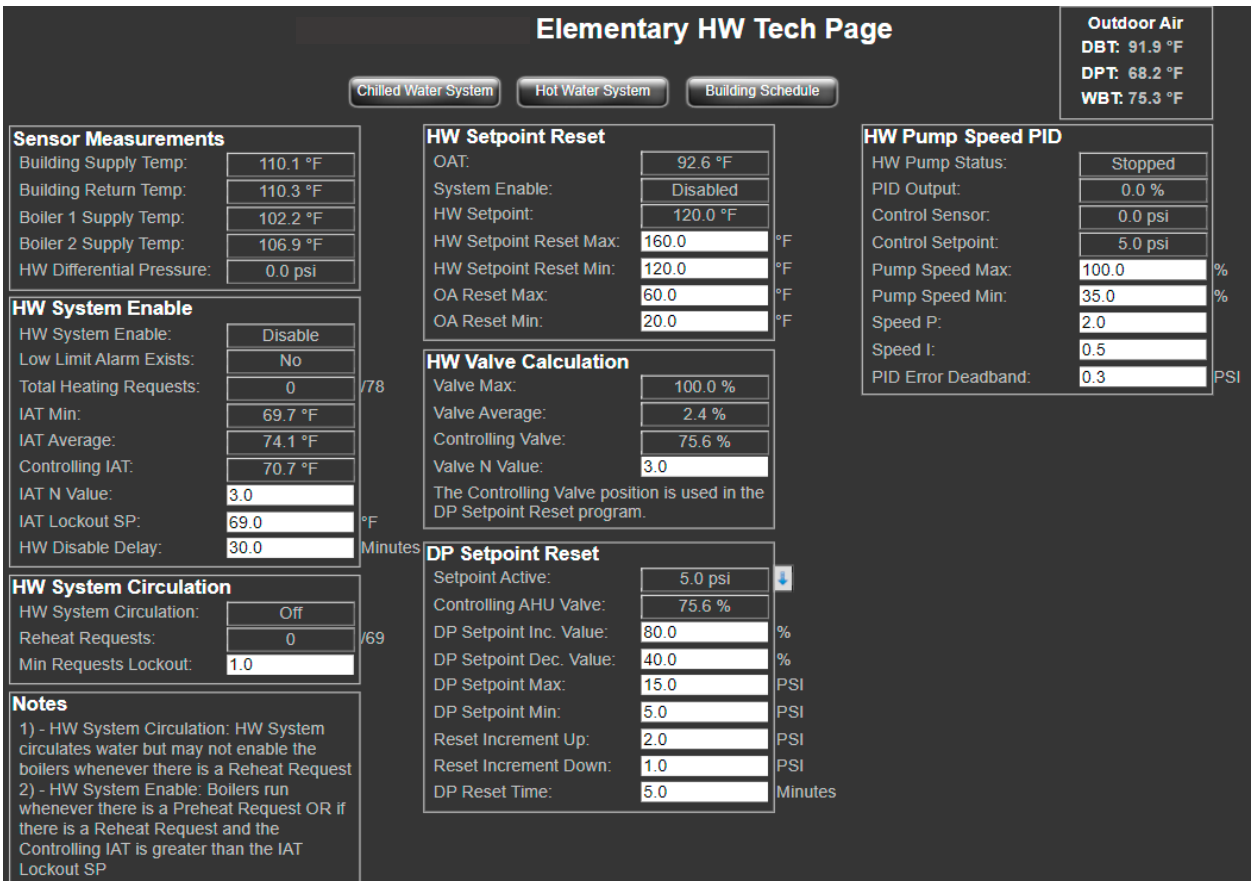
The screenshot examples below most closely capture the desired intent; although any/all examples may have some items in compliance with requirements and other items that are not.




Junior High
Hot Water Dynamic Sequence REV 9.2
Boiler System Enable
Enable the Boiler whenever ALL the following are TRUE
Manual Disable – OFF
Disabled
Call for Heating > 0
0
Avg Min Space T < Boiler IAT Lockout - 1°F
Disable the Boiler whenever ANY of the following are TRUE
Manual Disable – ON
Disabled
Call for Heating – 0 for 30 minutes (Adj.)
0
Minimum Applicable Space T > Boiler IAT Lockout + 1°F
Boiler System Current/Adjustable Values
Hot Water System Enable Enabled
Boiler IAT Lockout SP 69.0
Enable Boiler IAT Lockout SP 1.0
Call For Heating Disable Timer 30
Disable Boiler IAT Lockout SP 0.0
Minimum Applicable Space Temp 71.9
Current Boiler IAT Lockout SP 1.0
HHW Pump Control
Energize the pump whenever ANY of the following are TRUE
Call for Heating > 0
True
De-energize the pump whenever ALL the following are TRUE
Call for Heating – 0
True
Boiler has been Disabled for 5 minutes (Adj.)
If the system has no DP sensor but has a VFD on the HWP then use a linear
reset schedule to ramp the VFD from max speed (30Hz or 50% Adj.) to min speed
(50Hz or 83% Adj.) as the HWRT goes from (HWST - 20°F Adj.) to (HWST - 10°F Adj.).
HHW Pump Control Current/Adjustable Values
Boiler Has Been Disable Timer 1.0
Hot Water Pump Enabled Off
Hot Water Pump VFD Max Speed 0.0 %
Hot Water Pump VFD Min Speed 0.0 %
Hot Water Supply Min SP Offset 0.0
Hot Water Supply Min Current SP 0.0
Hot Water Supply Max SP Offset 30.0
Hot Water Supply Max Current SP 0.0
VFD Speed Signal 0.0
Hot Water Supply Temperature 84.4 *LOW*
Hot Water Return Temperature 131.3
Oat Low Temp SP 0.0 °F
Oat High Temp SP 0.0 °F
Controlling Min Space Temp Dial 1
HHW Temperature Control
Modulate the Mixing Valve between Min & Max to maintain Bldg.
Supply Temperature at Setpoint
True
Setpoint reset
OAT
True
20F
45F
True
Min – 10% (Adj.) open to the Boiler
Max Position follows the following linear reset schedule
Boiler Supply T
140F
160F
HHW Temperature Control Current/Adjustable Values
Hw Mixing Vlv Kp 0.0
Hw Mixing Vlv Ki 0.0
Hw Mixing Vlv Stroke Time 0.0 sec
Mixing Valve Position 0.0
Hw Mixing Valve Min Position 0.0 %
High Hot Water Temp SP 0.0 °F
Low Hot Water Temp SP 0.0 °F
Boiler Max Temp Setpoint 135.0 °F
Boiler Min Temp Setpoint 135.2 °F
HotWaterSupplyTemperature 84.4 *LOW*
Hot Water Supply SP 130.0
Mixing Valve Max Position 0.0 %
Mixing Valve Min Position 0.0 %
HWP Enable No
Run Requests 0.0
Emergency Shutdown Disabled
Boiler Manager
73.9 WBT
OA Conditions 65.8 DPT
90.0 °F
Low Temp Alm
Normal
Setpoint
140.0 °F
BLDG HWS
85.5 °F
Mixing Valve
10.0 %
BLR HWS
85.0 °F
HWP 1
S/S Off
Status Off
Speed 0.0 %
-1.0 PSI
BLDG DP
5.0 PSI
Setpoint
Boiler 1
Enable Off
Alarm Normal
Fan Off
Disable Boiler No
BLDG HWR
84.4 °F


Box Run Requests 0.0
Run Requests 0.0
Emergency Shutdown Disabled
Boiler Manager
OA Conditions 73.9 WBT 65.8 DPT 90.0 °F
Rev 12.4
HHW Distribution Pump Start/Stop
HHW Distribution Pump Speed Control
Boiler Start/Stop
Boiler Indoor Air Temperature Lockout Setpoint = 70°F (adj)
IAT Lockout SP 69.0 °F
Average Space T = Average space T for the entire building
Average Space T 73.5 °F
Where: Average Space T = the sum of the average space temperatures served by each AHU divided by the number of AHU's
Minimum Space T = Minimum space T for the entire building
Minimum Space T 72.0 °F
Where: Minimum Space T = the sum of the minimum space temperatures served by each AHU divided by the number of AHU's
Controlling Min Space T = (Average Space T + (N * Minimum Space T))/(N + 1)
Controlling Min Space T 72.8 °F
N is an adjustable number that can be thought of as a minimum value weighting factor, starting Value for N = 0 in this case
Weight (N) 1.0
Enable the Boiler whenever ALL the following are TRUE
Boiler Enable OFF
Manual Disable = OFF
Manual Disable AUTO
Heat Requests > 0
Heat Run Requests 0.0
Any Bldg. HWP is ON
HWP-1 S/S OFF
Any of the following are True
Controlling Min Space T < Boiler IAT Lockout - .5°F (adj)
Boiler IAT Lockout DB 0.5 °F
OAT < Freeze Prevention Setpoint (39°F, adj)
Freeze Prevention SP 39.0 °F
HWST < 65°F (adj)
Min HWST SP 65.0 °F
Disable the Boiler whenever ANY of the following are TRUE
Manual Disable = ON
Heat Requests = 0 for 15 minutes (adj)
Heat Request Off Delay 00:01:00


Hot Water System
Graphic
Status
Alarms
Data Logs
TGP2 Programs
Details
60.5 °F
54.9 °F
HVAC Emergency Shutdown: Normal
Chilled Water System
School Overview
HW Return: 77.3 °F
100.0 %
HW Supply: 76.0 °F
HWP - 01
HWP Start/Stop: Start
HWP Status: Off
HWP Failure: Alarm
Hot Water Plant Enable: Enabled
OA Reset Max Setpoint: 70.0 °F
OA Reset Min Setpoint: 20.0 °F
HW Reset Max Setpoint: 180.0 °F
HW Reset Min Setpoint: 140.0 °F
HW Supply Temp Setpoint: 147.6 °F
Temp Control Valve: 100.0 %
100% = Full Flow to Loop
0% = Full Bypass Of Loop
HW Supply Temp: 76.0 °F
HW Return Temp: 77.3 °F
Boiler Request: Off
Boiler Enable Command: Off
Boiler Mechanical Failure: Normal



AHU System

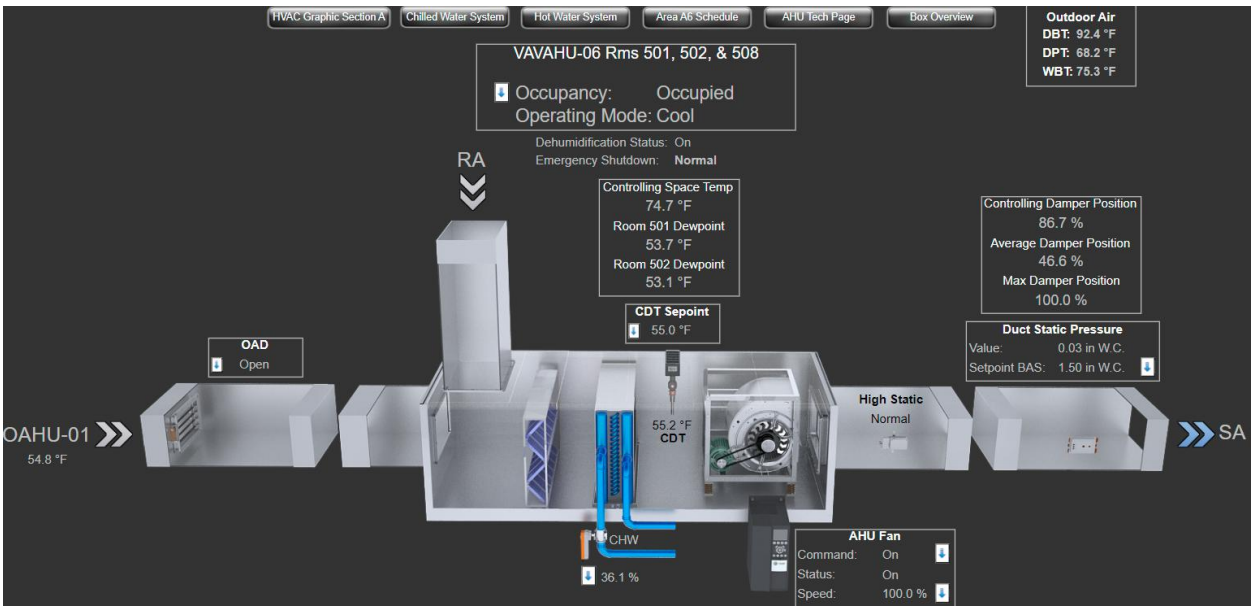
AHU System graphics vary by AHU type (SZ, VAV, MZ, OA, etc.). Due to the large number of AHU arrangements for each of these types, it is not possible to define all required items, so required elements are based on defining principles for these graphics.

Required Elements (Specification Requirements)

1. AHU Name with Areas/Rooms specifically served listed adjacent to the AHU name
2. AHU Occupancy State
3. AHU Mode State
4. All component values and associated setpoints; order in this graphic should match the order for the physical unit
5. Display of key commissioning/tuning variables
6. Links to box/zone overview pages for applicable AHUs (VAV and MZ AHU)
7. Links to Tech/Commissioning/Tuning Pages (ex. Sequence of Operation)
8. Links to navigate to the Cooling and/or Heating Plant serving the AHU

Example and Notes below are for clarification and illustrative purposes only and in no way does this information modify the required elements detailed above or in other areas of the Specifications

The screenshot examples below most closely capture the desired intent; although any/all examples may have some items in compliance with requirements and other items that are not.



VAVAHU-06 Rms 501, 502, & 508

GRAPHIC | STATUS | ALARMS | HISTORY | SUPPORT

Elementary AHU Tech Page

Chilled Water System | Hot Water System | Building Schedule | AHU Graphic

Outdoor Air
DBT: ---
DPT: ---
WBT: 75.3 °F

Calibration Factors

Supply Air Temperature:	55.2 °F
Offset:	0.0 °F
Duct Static Pressure:	---
Offset:	---

Space Setpoints

Average CSP:	---
Space Dewpoint:	---

These setpoints and the Controlling Values for Space Temp and Space dpT below are used in the Discharge Air Reset program.

Heat Cool Mode

Value:	Cool
Dehumidification Status:	On
Box(es) in Cool Mode:	---

Cool Mode is activated if any box is in Cool Mode or if controlling Space dpT rises above dpT SP, deactived if no box is in Cool Mode and Dehumidification Mode is OFF.

Supply Air Setpoint Reset

SAT SP Current Value:	55.0 °F	
Cooling SP Max:	---	°F
Dehum SP Max:	---	°F
Common SP Min:	---	°F
SAT SP Inc./Dec. Logic Values		
Space T Setpoint (CSP):	---	
Controlling Space T (CST):	74.7 °F	
Dec. when CST > CSP by:	1.0 °F	
Inc. when CST < CSP by:	2.0 °F	
Inc./Dec. by:	---	°F
Inc./Dec. every:	---	Minutes

If Controlling Space dpT > dpT SP by 2°F then Dehum = ON, until Controlling Space dpT < dpT SP by 2°F
When Dehum = ON, then the Dehum SP Max is active

SAT PID Tuning

Sensor Value:	55.2 °F	
Cooling Setpoint:	55.0 °F	
Cooling PID Output:	---	
Cooling P:	---	
Cooling I:	---	
PID Error Deadband:	---	°F

Controlling Space Temp Calculation

Temperature Max:	---
Temperature Average:	---
Controlling Temperature:	---
Temperature N Value:	---

Controlling Space DPT Calculation

Dewpoint Max:	---
Dewpoint Average:	---
Controlling Dewpoint:	---
Dewpoint N Value:	---

Duct Static Optimization

Controlling Damper:	86.7 %	
DSP Value:	0.0 in W.C.	
DSP Setpoint:	1.5 in W.C.	
Reset Up Damper Postion:	---	%
Reset Down Damper Position:	---	%
Initial DSP Setpoint:	---	In W.C.
Reset Max:	---	In W.C.
Reset Min:	---	In W.C.
Reset Increment:	---	In W.C.
Reset Decrement:	---	In W.C.
Reset Time Increment:	---	Minutes

Supply Fan PID Tuning

Value:	100.0 %	
Duct Static Pressure:	---	
Duct Static Pressure SP:	1.5 in W.C.	
Supply Fan P:	---	
Supply Fan I:	---	
PID Error Deadband:	---	%

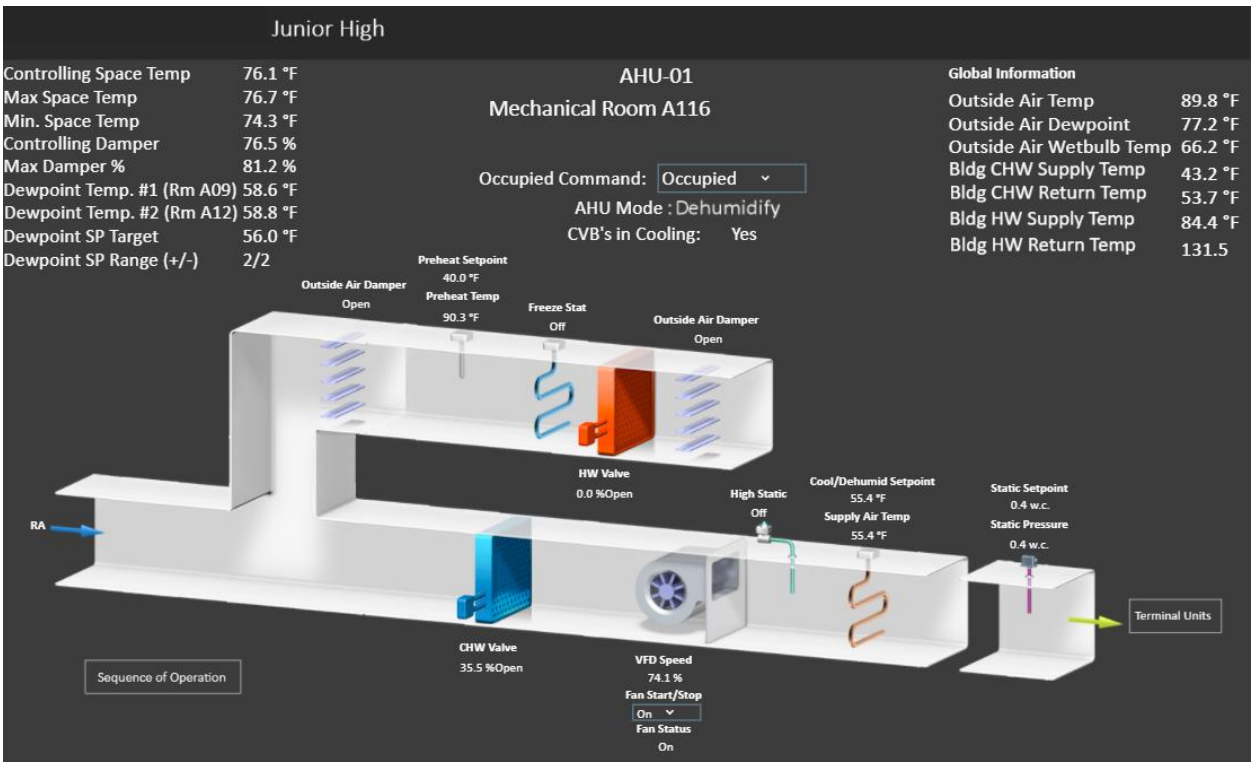
Controlling Space Damper Calculation

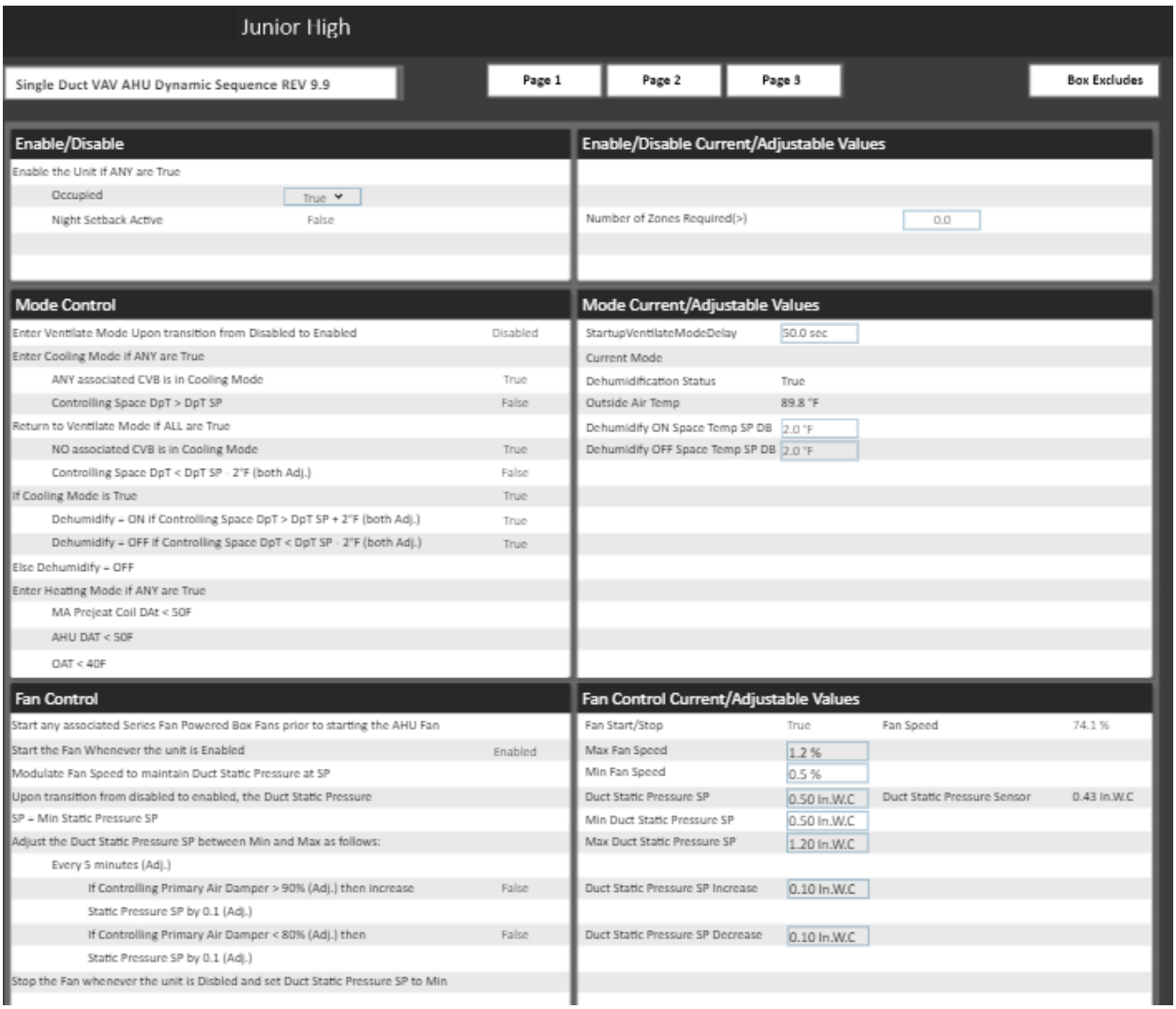
Damper Max:	100.0 %
Damper Average:	46.6 %
Controlling Damper:	86.7 %
Damper N Value:	---

The Controlling Damper position is used in the Duct Static Optimization program below.

Notes

1) - In general, each section on this page is related to a specific program in the system
2) - Controlling Value = (Avg + N * Max)/(N+1)
3) - The N Value can de thought of as a Max Value weighting factor


Junior High
Controlling Space Temp 76.1 °F
Max Space Temp 76.7 °F
Min. Space Temp 74.3 °F
Controlling Damper 76.5 %
Max Damper % 81.2 %
Dewpoint Temp. #1 (Rm A09) 58.6 °F
Dewpoint Temp. #2 (Rm A12) 58.8 °F
Dewpoint SP Target 56.0 °F
Dewpoint SP Range (+/-) 2/2
AHU-01
Mechanical Room A116
Occupied Command: Occupied
AHU Mode : Dehumidify
CVB's in Cooling: Yes
Global Information
Outside Air Temp 89.8 °F
Outside Air Dewpoint 77.2 °F
Outside Air Wetbulb Temp 66.2 °F
Bldg CHW Supply Temp 43.2 °F
Bldg CHW Return Temp 53.7 °F
Bldg HW Supply Temp 84.4 °F
Bldg HW Return Temp 131.5
Outside Air Damper
Open
Preheat Setpoint
40.0 °F
Preheat Temp
90.3 °F
Freeze Stat
Off
Outside Air Damper
Open
HW Valve
0.0 %Open
High Static
Off
Cool/Dehumid Setpoint
55.4 °F
Supply Air Temp
55.4 °F
Static Setpoint
0.4 w.c.
Static Pressure
0.4 w.c.
RA
Terminal Units
CHW Valve
35.5 %Open
VFD Speed
74.1 %
Fan Start/Stop
On
Fan Status
On
Sequence of Operation


Junior High
Single Duct VAV AHU Dynamic Sequence REV 9.9
Page 1
Page 2
Page 3
Box Excludes
Enable/Disable
Enable the Unit if ANY are True
Occupied
True
Night Setback Active
False
Enable/Disable Current/Adjustable Values
Number of Zones Required(>)
0.0
Mode Control
Enter Ventilate Mode Upon transition from Disabled to Enabled
Disabled
Enter Cooling Mode if ANY are True
ANY associated CVB is in Cooling Mode
True
Controlling Space DpT > DpT SP
False
Return to Ventilate Mode if ALL are True
NO associated CVB is in Cooling Mode
True
Controlling Space DpT < DpT SP - 2°F (both Adj.)
False
If Cooling Mode is True
True
Dehumidify – ON if Controlling Space DpT > DpT SP + 2°F (both Adj.)
True
Dehumidify – OFF if Controlling Space DpT < DpT SP - 2°F (both Adj.)
True
Else Dehumidify – OFF
Enter Heating Mode if ANY are True
MA Preheat Coil DAt < 50F
AHU DAT < 50F
OAT < 40F
Mode Current/Adjustable Values
StartupVentilateModeDelay
50.0 sec
Current Mode
Dehumidification Status
True
Outside Air Temp
89.8 °F
Dehumidify ON Space Temp SP DB
2.0 °F
Dehumidify OFF Space Temp SP DB
2.0 °F
Fan Control
Start any associated Series Fan Powered Box Fans prior to starting the AHU Fan
Start the Fan Whenever the unit is Enabled
Enabled
Modulate Fan Speed to maintain Duct Static Pressure at SP
Upon transition from disabled to enabled, the Duct Static Pressure
SP – Min Static Pressure SP
Adjust the Duct Static Pressure SP between Min and Max as follows:
Every 5 minutes (Adj.)
If Controlling Primary Air Damper > 90% (Adj.) then increase
False
Static Pressure SP by 0.1 (Adj.)
If Controlling Primary Air Damper < 80% (Adj.) then
False
Static Pressure SP by 0.1 (Adj.)
Stop the Fan whenever the unit is Disbled and set Duct Static Pressure SP to Min
Fan Control Current/Adjustable Values
Fan Start/Stop
True
Fan Speed
74.1 %
Max Fan Speed
1.2 %
Min Fan Speed
0.5 %
Duct Static Pressure SP
0.50 In.W.C
Duct Static Pressure Sensor
0.43 In.W.C
Min Duct Static Pressure SP
0.50 In.W.C
Max Duct Static Pressure SP
1.20 In.W.C
Duct Static Pressure SP Increase
0.10 In.W.C
Duct Static Pressure SP Decrease
0.10 In.W.C

Box/Zone System

Box/Zone System graphics vary by type (CV, TU, MZ, etc.). Due to the large number of Box/Zone arrangements for each of these types, it is not possible to define all required items, so required elements are based on defining principles for these graphics.

Required Elements (Specification Requirements)

1. Box/Zone Name with Areas/Rooms specifically served listed adjacent to the Box/Zone name
2. Box/Zone Occupancy State
3. Box/Zone Mode State
4. All component values and associated setpoints; order in this graphic should match the order for the physical unit

5. Display of key commissioning/tuning variables
6. Links back to applicable AHU (AHU serving box/zone)
7. Links to Tech/Commissioning/Tuning Pages (ex. Sequence of Operation)

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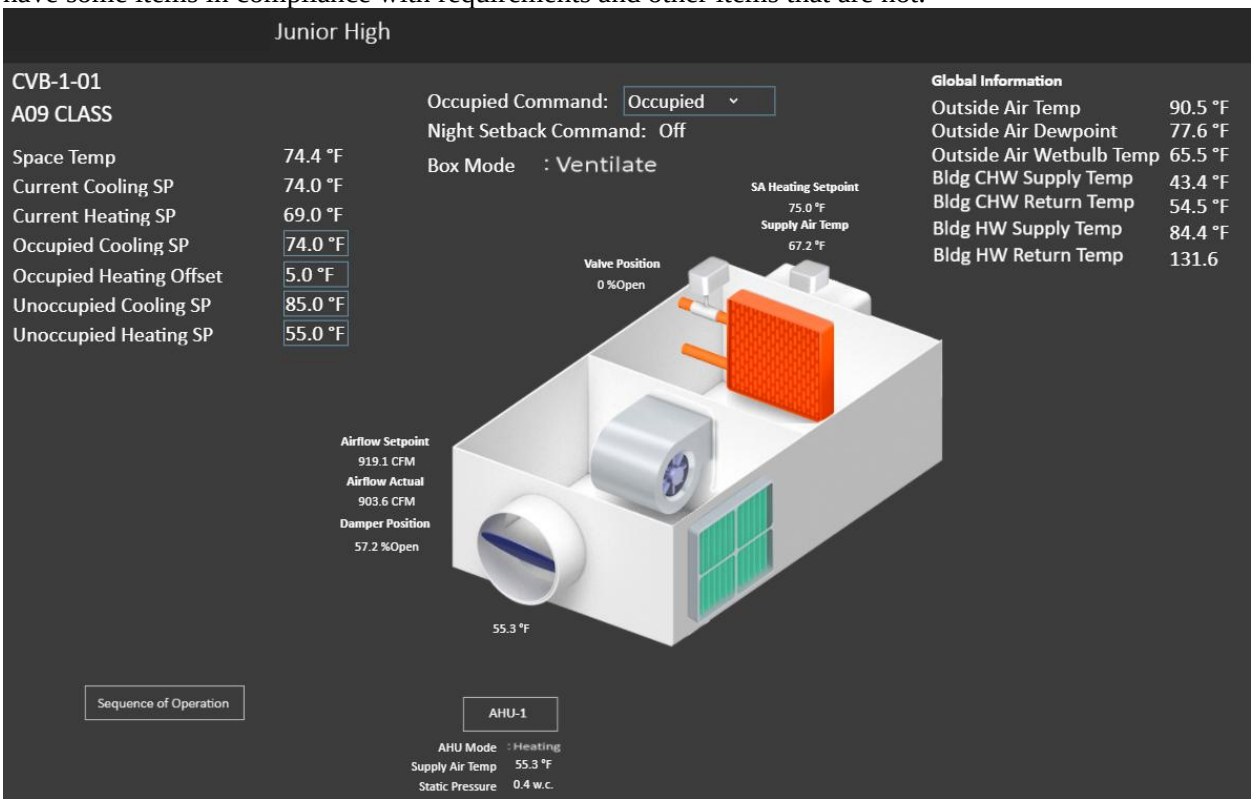
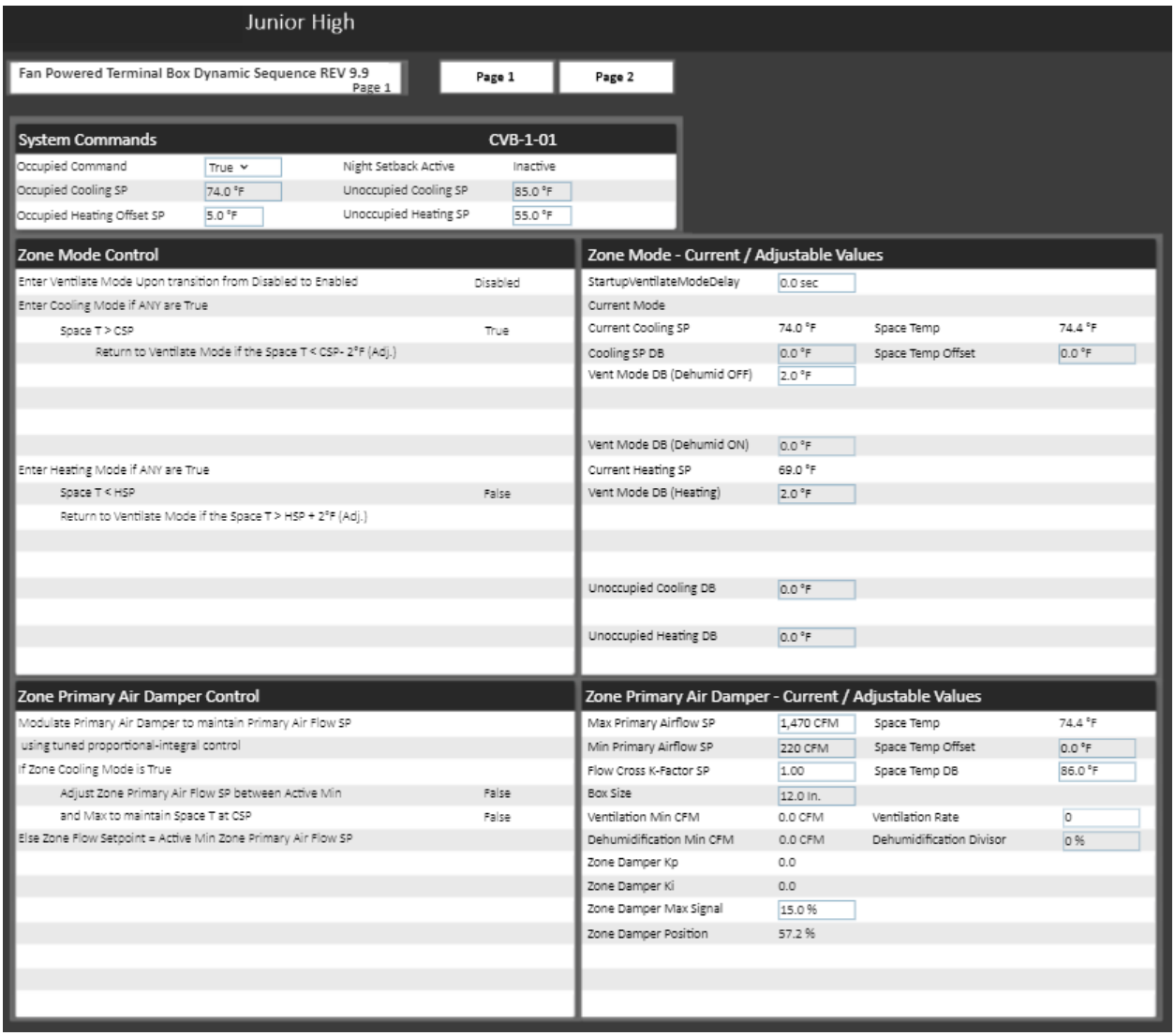
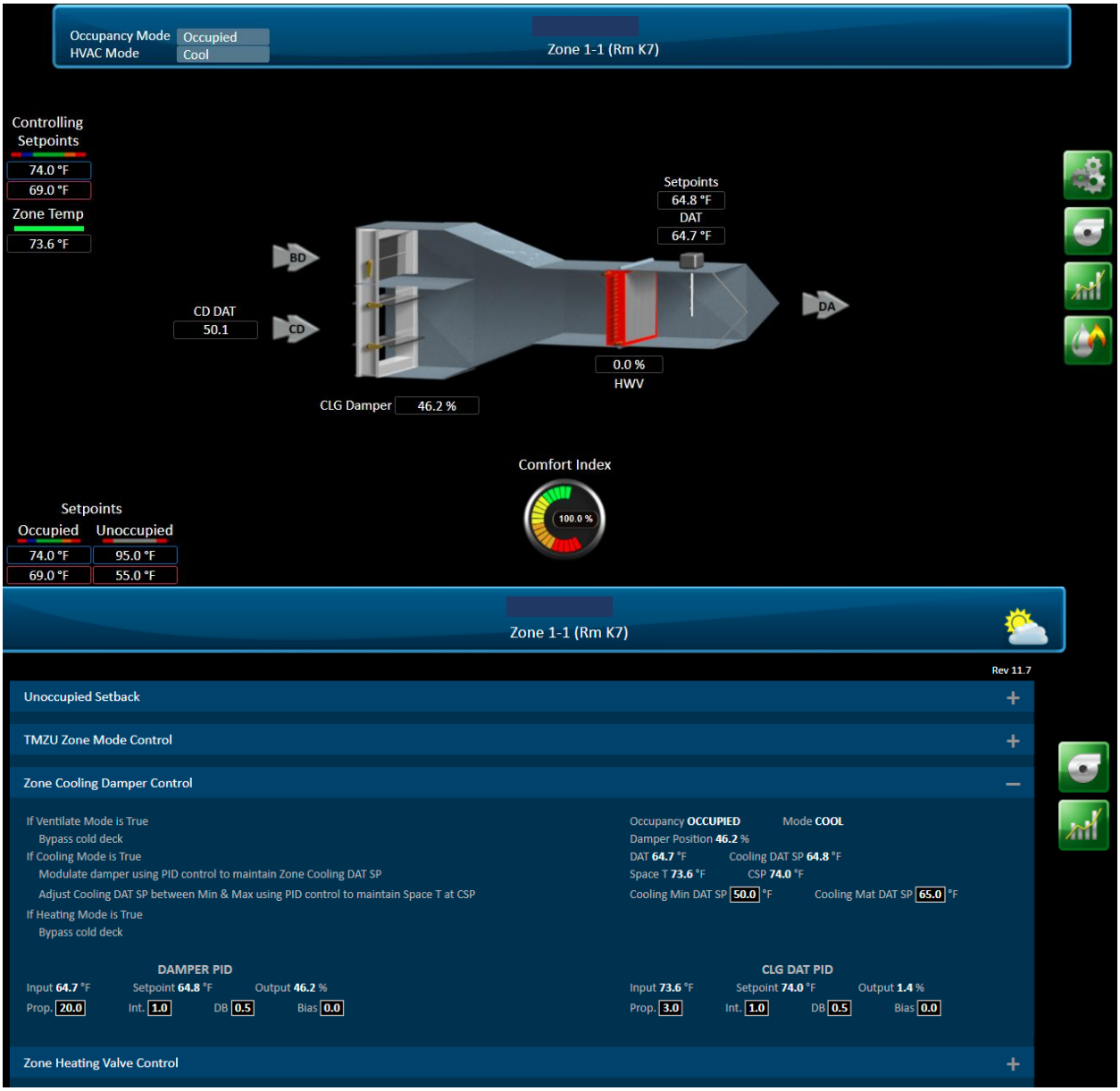
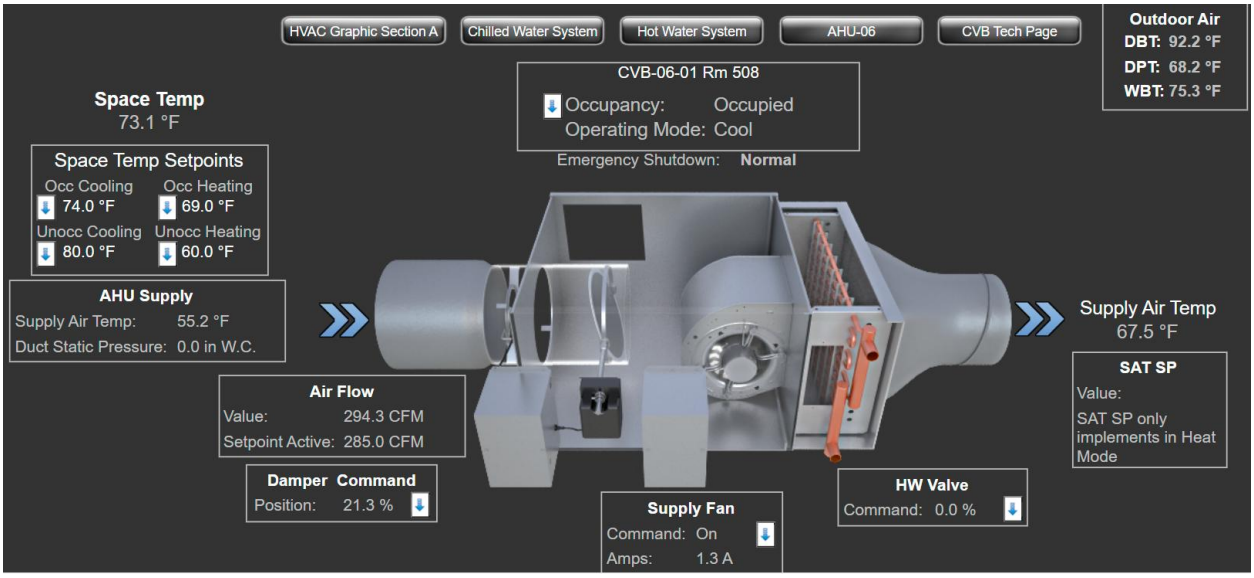
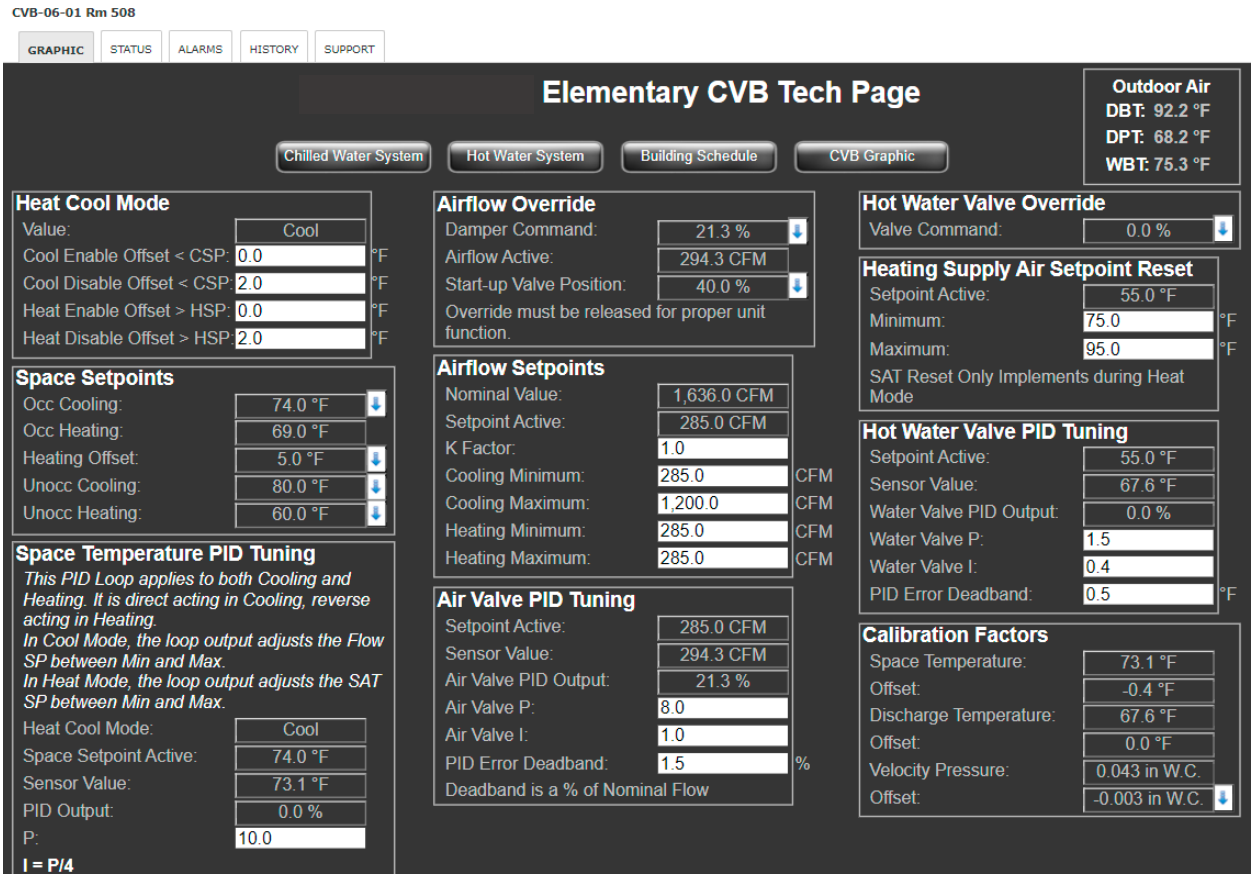



Junior High
Fan Powered Terminal Box Dynamic Sequence REV 9.9
Page 1
Page 1
Page 2
System Commands
CVB-1-01
Occupied Command
True
Night Setback Active
Inactive
Occupied Cooling SP
74.0 °F
Unoccupied Cooling SP
85.0 °F
Occupied Heating Offset SP
5.0 °F
Unoccupied Heating SP
55.0 °F
Zone Mode Control
Enter Ventilate Mode Upon transition from Disabled to Enabled
Disabled
Enter Cooling Mode if ANY are True
Space T > CSP
True
Return to Ventilate Mode if the Space T < CSP- 2°F (Adj.)
Enter Heating Mode if ANY are True
Space T < HSP
False
Return to Ventilate Mode if the Space T > HSP + 2°F (Adj.)
Zone Mode - Current / Adjustable Values
StartupVentilateModeDelay
0.0 sec
Current Mode
Current Cooling SP
74.0 °F
Space Temp
74.4 °F
Cooling SP DB
0.0 °F
Space Temp Offset
0.0 °F
Vent Mode DB (Dehumid OFF)
2.0 °F
Vent Mode DB (Dehumid ON)
0.0 °F
Current Heating SP
69.0 °F
Vent Mode DB (Heating)
2.0 °F
Unoccupied Cooling DB
0.0 °F
Unoccupied Heating DB
0.0 °F
Zone Primary Air Damper Control
Modulate Primary Air Damper to maintain Primary Air Flow SP
using tuned proportional-integral control
If Zone Cooling Mode is True
Adjust Zone Primary Air Flow SP between Active Min
False
and Max to maintain Space T at CSP
False
Else Zone Flow Setpoint = Active Min Zone Primary Air Flow SP
Zone Primary Air Damper - Current / Adjustable Values
Max Primary Airflow SP
1,470 CFM
Space Temp
74.4 °F
Min Primary Airflow SP
220 CFM
Space Temp Offset
0.0 °F
Flow Cross K-Factor SP
1.00
Space Temp DB
86.0 °F
Box Size
12.0 in.
Ventilation Min CFM
0.0 CFM
Ventilation Rate
0
Dehumidification Min CFM
0.0 CFM
Dehumidification Divisor
0 %
Zone Damper Kp
0.0
Zone Damper Ki
0.0
Zone Damper Max Signal
15.0 %
Zone Damper Position
57.2 %


Occupancy Mode
Occupied
HVAC Mode
Cool
Zone 1-1 (Rm K7)
Controlling Setpoints
74.0 °F
69.0 °F
Zone Temp
73.6 °F
Setpoints
64.8 °F
DAT
64.7 °F
BD
CD DAT
50.1
CD
DA
0.0 %
HWV
CLG Damper
46.2 %
Comfort Index
100.0 %
Setpoints
Occupied
Unoccupied
74.0 °F
95.0 °F
69.0 °F
55.0 °F
Zone 1-1 (Rm K7)
Rev 11.7
Unoccupied Setback
TMZU Zone Mode Control
Zone Cooling Damper Control
If Ventilate Mode is True
Bypass cold deck
If Cooling Mode is True
Modulate damper using PID control to maintain Zone Cooling DAT SP
Adjust Cooling DAT SP between Min & Max using PID control to maintain Space T at CSP
If Heating Mode is True
Bypass cold deck
Occupancy OCCUPIED
Mode COOL
Damper Position 46.2 %
DAT 64.7 °F
Cooling DAT SP 64.8 °F
Space T 73.6 °F
CSP 74.0 °F
Cooling Min DAT SP 50.0 °F
Cooling Mat DAT SP 65.0 °F
DAMPER PID
Input 64.7 °F
Setpoint 64.8 °F
Output 46.2 %
Prop. 20.0
Int. 1.0
DB 0.5
Bias 0.0
CLG DAT PID
Input 73.6 °F
Setpoint 74.0 °F
Output 1.4 %
Prop. 3.0
Int. 1.0
DB 0.5
Bias 0.0
Zone Heating Valve Control





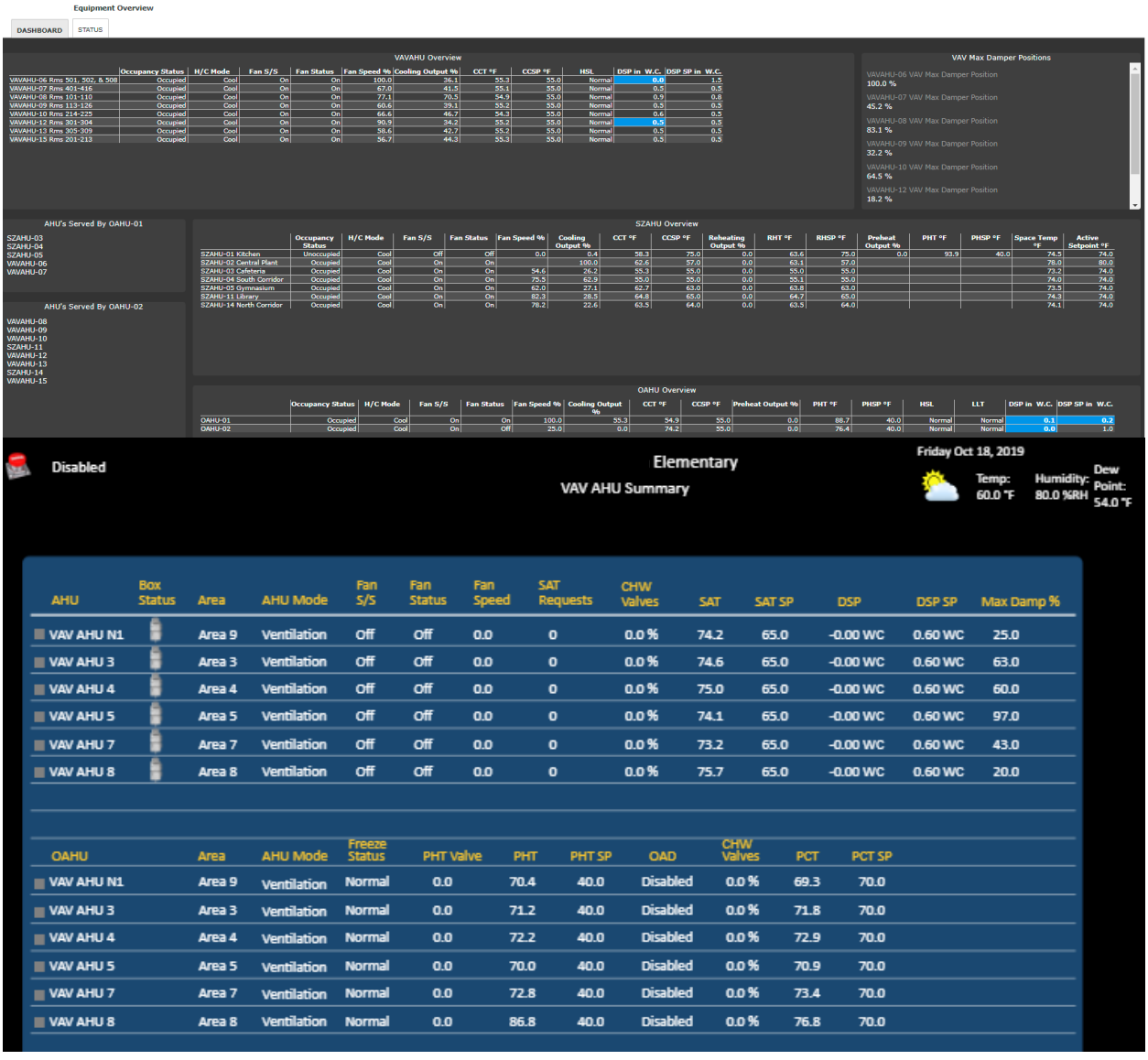
Equipment Overviews

Equipment Overviews are tables with point values for differing AHUs (SZ, VAV, MZ, OA, etc.). Due to the large number of AHU arrangements for each of these types, it is not possible to list all required items, so required elements are based on defining principles for these overviews.

Required Elements (Specification Requirements)

1. AHU Name (with Area served and links directly to HVAC equipment graphics)
2. AHU Mode State
3. All component values and associated setpoints; order in this table should match the order for the graphic and for the physical unit

Example and Notes below are for clarification and illustrative purposes only and in no way does this information modify the required elements detailed above or in other areas of the Specifications
The screenshot examples below most closely capture the desired intent; although any/all examples may have some items in compliance with requirements and other items that are not.



AHU	Box Status	Area	AHU Mode	Fan S/S	Fan Status	Fan Speed	SAT Requests	CHW Valves	SAT	SAT SP	DSP	DSP SP	Max Damp %
VAV AHU N1		Area 9	Ventilation	Off	Off	0.0	0	0.0 %	74.2	65.0	-0.00 WC	0.60 WC	25.0
VAV AHU 3		Area 3	Ventilation	Off	Off	0.0	0	0.0 %	74.6	65.0	-0.00 WC	0.60 WC	63.0
VAV AHU 4		Area 4	Ventilation	Off	Off	0.0	0	0.0 %	75.0	65.0	-0.00 WC	0.60 WC	60.0
VAV AHU 5		Area 5	Ventilation	Off	Off	0.0	0	0.0 %	74.1	65.0	-0.00 WC	0.60 WC	97.0
VAV AHU 7		Area 7	Ventilation	Off	Off	0.0	0	0.0 %	73.2	65.0	-0.00 WC	0.60 WC	43.0
VAV AHU 8		Area 8	Ventilation	Off	Off	0.0	0	0.0 %	75.7	65.0	-0.00 WC	0.60 WC	20.0

OAHU	Area	AHU Mode	Freeze Status	PHT Valve	PHT	PHT SP	OAD	CHW Valves	PCT	PCT SP
VAV AHU N1	Area 9	Ventilation	Normal	0.0	70.4	40.0	Disabled	0.0 %	69.3	70.0
VAV AHU 3	Area 3	Ventilation	Normal	0.0	71.2	40.0	Disabled	0.0 %	71.8	70.0
VAV AHU 4	Area 4	Ventilation	Normal	0.0	72.2	40.0	Disabled	0.0 %	72.9	70.0
VAV AHU 5	Area 5	Ventilation	Normal	0.0	70.0	40.0	Disabled	0.0 %	70.9	70.0
VAV AHU 7	Area 7	Ventilation	Normal	0.0	72.8	40.0	Disabled	0.0 %	73.4	70.0
VAV AHU 8	Area 8	Ventilation	Normal	0.0	86.8	40.0	Disabled	0.0 %	76.8	70.0

CARDIFF_JH_MZU_SUMMARY

	Occupied Command	Supply Fan Status	Supply Air Temp °F	Supply Air Temp SP °F	Average Space Temp °F	Highest Space Temp °F	Space Dewpoint °F	VFD Speed %	CHWV Position %
Cardiff JH MZU-01	Occupied	On	55.7	55.0	72.9	73.5	56.8	100.0	29
Cardiff JH MZU-02	Occupied	On	56.2	55.0	73.8	73.8	56.4	100.0	77
Cardiff JH MZU-03	Occupied	On	57.4	55.0	72.4	74.1	56.1	100.0	99
Cardiff JH MZU-04	Occupied	On	56.5	55.0	72.8	72.8	54.0	100.0	72
Cardiff JH MZU-05	Occupied	On	61.2	55.0	73.6	73.6	57.2	100.0	100
Cardiff JH MZU-06	Occupied	On	56.0	55.0	73.4	73.4	56.2	100.0	47
Cardiff JH MZU-07	Occupied	On	56.0	55.0	74.6	74.6	57.2	100.0	35
Cardiff JH MZU-08	Occupied	On	54.6	47.0	72.5	73.7	55.5	100.0	90
Cardiff JH MZU-09	Occupied	On	53.3	47.0	73.2	73.2	53.9	100.0	56
Cardiff JH MZU-10	Occupied	On	56.0	55.0	74.0	74.8	57.1	75.0	50

Space Overviews

Space Overviews are tables with point values for differing Boxes/Zones (CV, TU, MZ, etc.). Due to the large number of Box/Zone arrangements for each of these types, it is not possible to list all required items, so required elements are based on defining principles for these overviews.

Required Elements (Specification Requirements)

1. Box/Zone Name with Areas/Rooms specifically served listed adjacent to the Box/Zone name
2. Box/Zone Mode State
3. All component values and associated setpoints; order in this table should match the order for the graphic and for the physical unit

Example and Notes below are for clarification and illustrative purposes only and in no way does this information modify the required elements detailed above or in other areas of the Specifications

The screenshot examples below most closely capture the desired intent for the Space Overviews. Both examples have some items in compliance with requirements and other items that are not.

WOODCREEK_JH_ZONE_SUMMARY

	Occupied Command	Unit Alarm	Supply Air Temp °F	Space Temp °F	Space Temp Setpoint °F	Occupied Heating Offset °F	Cold Deck Mixing Damper %	HWV Position %
Device 3590218	Occupied	Normal	65.3	72.9	76.0	5	54.8	0.0
WoodCreek JH ZN-1-01 1130	Occupied	Normal	64.3	72.4	73.0	6	51.6	0.0
WoodCreek JH ZN-1-02 1126	Occupied	Normal	64.3	73.5	74.0	6	35.0	0.0
WoodCreek JH ZN-1-03 1125	Occupied	Normal	64.3	72.2	74.0	6	54.2	0.0
WoodCreek JH ZN-1-04 A128	Occupied	Normal	64.3	72.2	74.0	5	48.7	0.0
WoodCreek JH ZN-2-1 Cor A131	Occupied	Normal	63.3	73.6	74.0	6	52.9	0.0
WoodCreek JH ZN-2-10 1119	Occupied	Normal	65.3	72.4	74.0	6	53.3	0.0
WoodCreek JH ZN-2-2 Cor A131	Occupied	Normal	64.9	74.5	74.0	6	46.2	0.0
WoodCreek JH ZN-2-3 C 1114	Occupied	Normal	65.8	72.7	74.0	6	60.8	0.0
WoodCreek JH ZN-2-4 C 1116	Occupied	Normal	64.4	72.1	74.0	6	50.5	0.0
WoodCreek JH ZN-2-5 Art 1122	Occupied	Normal	55.6	74.0	72.0	6	100.0	0.0
WoodCreek JH ZN-2-6 Art 1124	Occupied	Normal	56.9	74.0	72.0	6	100.0	0.0
WoodCreek JH ZN-2-7 Cor	Occupied	Normal	61.1	73.9	74.0	6	74.1	0.0
WoodCreek JH ZN-2-8 1123A	Occupied	Normal	63.8	73.7	74.0	6	60.1	0.0
WoodCreek JH ZN-2-9 TL 1121	Occupied	Normal	63.8	73.5	73.0	6	72.1	0.0
WoodCreek JH ZN-3-1 W 1133	Occupied	Normal	65.6	72.9	74.0	6	58.9	0.0

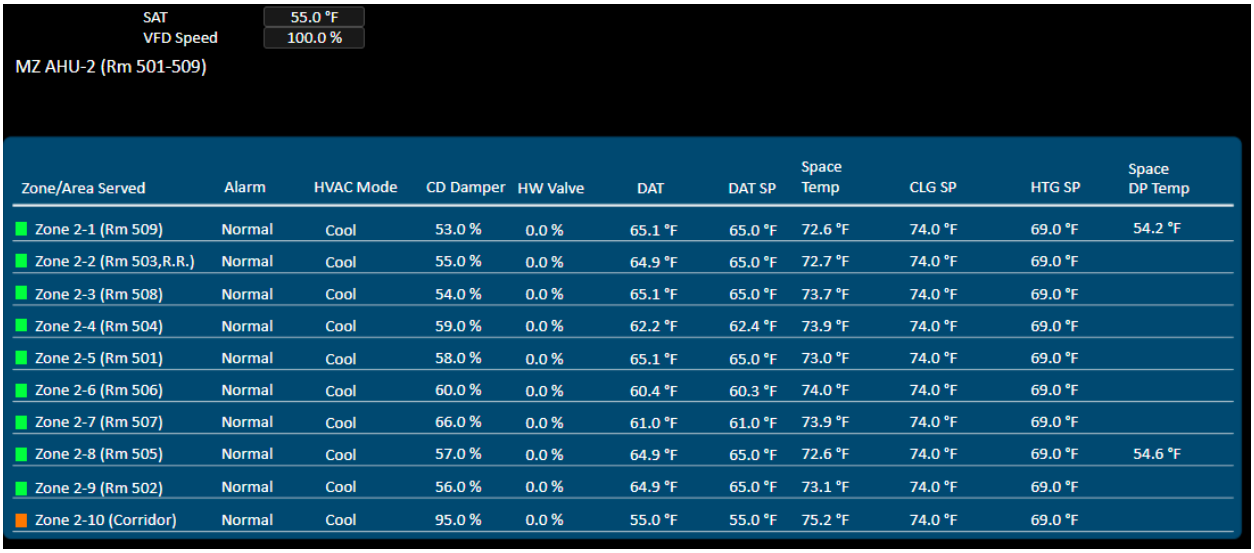
Elementary VAVAHU-06 Box Overview

VAVAHU-06 Overview

	Occupancy Status	Heat Cool Mode Status	Supply Fan Status	SAT °F	SAT Setpoint °F	Duct Static Pressure Active in W.C.	Duct Static Pressure Setpoint Active in W.C.	High Static Alarm
VAVAHU-06 Rms 501, 502, & 508	Occupied	Cool	On	55.4	55.0	0.0	1.5	Normal

VAVAHU-06 Box Overview

	Occupancy Status	Heat Cool Mode Status	Damper Command %	Primary Air Flow CFM	Primary Air Flow SP CFM	Fan Output	Fan Amps A	Heating Command %	SAT °F	Space Temperature Active °F	Occupied Cooling Setpoint °F	Occupied Heating Setpoint °F
CVB-06-01 Rm 508	Occupied	Cool	21.3	291.2	285.0	On	1.3	0.0	67.7	73.2	74.0	69.0
CVB-06-02 Rm 501	Occupied	Cool	55.8	333.9	259.9	On	0.4	0.0	64.1	73.2	74.0	69.0
CVB-06-03 Rm 501	Occupied	Cool	40.0	120.5	286.7	On	0.3	0.0	71.1	73.1	74.0	69.0
CVB-06-04 Rm 502	Occupied	Cool	100.0	283.6	750.0	On	0.5	0.0	69.5	75.2	74.0	69.0
CVB-06-05 Rm 502	Occupied	Cool	41.9	122.7	700.0	On	0.3	0.0	72.4	75.2	74.0	69.0



Zone/Area Served	Alarm	HVAC Mode	CD Damper	HW Valve	DAT	DAT SP	Space Temp	CLG SP	HTG SP	Space DP Temp
Zone 2-1 (Rm 509)	Normal	Cool	53.0 %	0.0 %	65.1 °F	65.0 °F	72.6 °F	74.0 °F	69.0 °F	54.2 °F
Zone 2-2 (Rm 503,R.R.)	Normal	Cool	55.0 %	0.0 %	64.9 °F	65.0 °F	72.7 °F	74.0 °F	69.0 °F	
Zone 2-3 (Rm 508)	Normal	Cool	54.0 %	0.0 %	65.1 °F	65.0 °F	73.7 °F	74.0 °F	69.0 °F	
Zone 2-4 (Rm 504)	Normal	Cool	59.0 %	0.0 %	62.2 °F	62.4 °F	73.9 °F	74.0 °F	69.0 °F	
Zone 2-5 (Rm 501)	Normal	Cool	58.0 %	0.0 %	65.1 °F	65.0 °F	73.0 °F	74.0 °F	69.0 °F	
Zone 2-6 (Rm 506)	Normal	Cool	60.0 %	0.0 %	60.4 °F	60.3 °F	74.0 °F	74.0 °F	69.0 °F	
Zone 2-7 (Rm 507)	Normal	Cool	66.0 %	0.0 %	61.0 °F	61.0 °F	73.9 °F	74.0 °F	69.0 °F	
Zone 2-8 (Rm 505)	Normal	Cool	57.0 %	0.0 %	64.9 °F	65.0 °F	72.6 °F	74.0 °F	69.0 °F	54.6 °F
Zone 2-9 (Rm 502)	Normal	Cool	56.0 %	0.0 %	64.9 °F	65.0 °F	73.1 °F	74.0 °F	69.0 °F	
Zone 2-10 (Corridor)	Normal	Cool	95.0 %	0.0 %	55.0 °F	55.0 °F	75.2 °F	74.0 °F	69.0 °F	

Humidity Sensor Overview

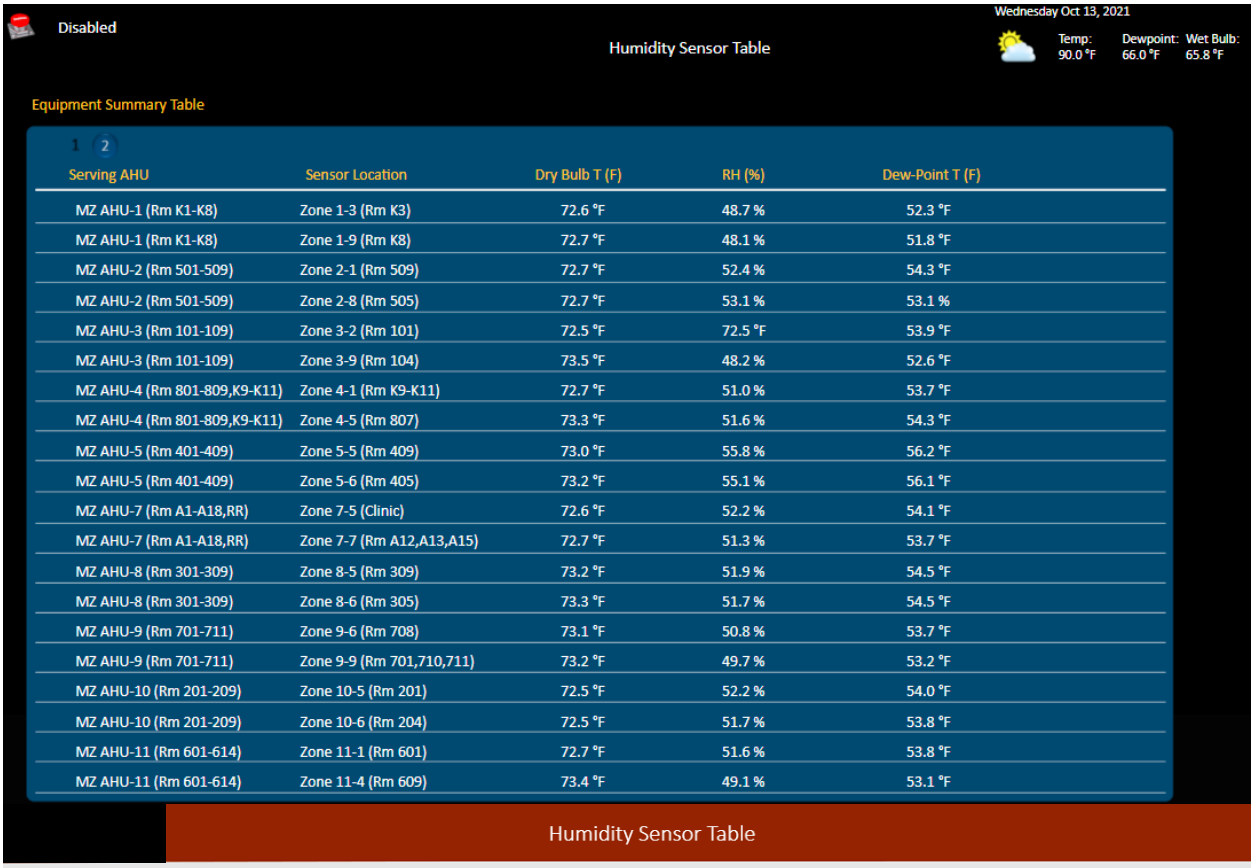
Humidity Sensor Overview is a table showing information for all indoor humidity sensors within a facility. The required elements for this overview are:

Required Elements (Specification Requirements)

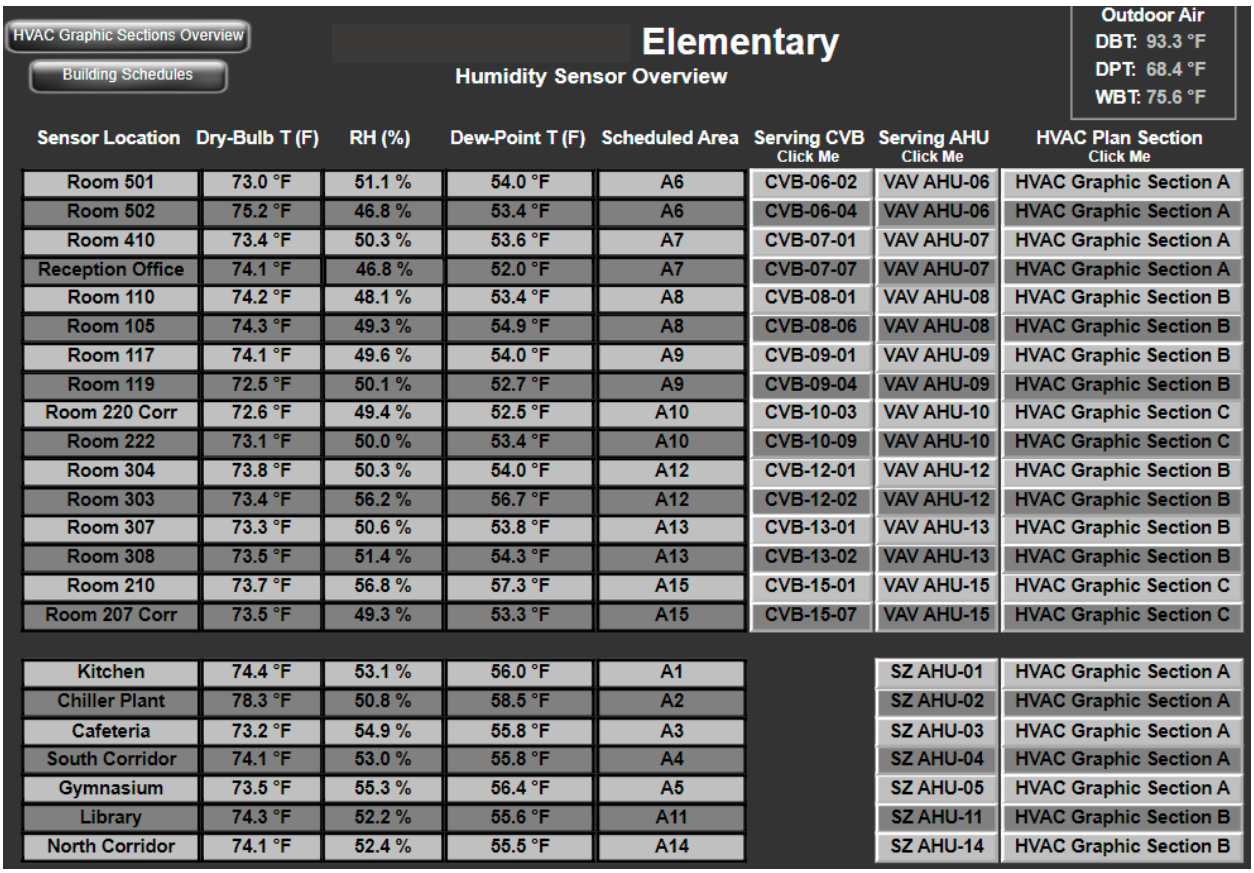
1. Equipment serving this humidity sensor as well as the Area/Room being served
2. Sensor Location
3. Dry Bulb Temp (measured by the sensor, units ºF)
4. RH (measured by the sensor in %)
5. Dew Point Temp (calculated from the dbT and RH, units ºF)

Example and Notes below are for clarification and illustrative purposes only and in no way does this information modify the required elements detailed above or in other areas of the Specifications

The screenshot examples below most closely capture the desired intent; although any/all examples may have some items in compliance with requirements and other items that are not.



Serving AHU	Sensor Location	Dry Bulb T (F)	RH%	Dew-Point T (F)
SZAHU-1	Gym Lobby	71.6 °F	64.8 %	59.2 °F
SZAHU-2	Practice Gym	71.5 °F	62.9 %	58.3 °F
SZAHU-3	Competition Gym	71.7 °F	70.5 %	61.6 °F
SZAHU-4	Boys Locker Room	72.0 °F	65.8 %	59.9 °F
SZAHU-5	Girls Locker Room	74.4 °F	55.4 %	57.5 °F
SZAHU-7	Cafeteria	71.5 °F	60.7 %	57.2 °F
SZAHU-8	Rotunda	73.9 °F	58.0 %	58.2 °F
SZAHU-9	Hallway	74.0 °F	57.3 %	58.0 °F
SZAHU-10	Stage	72.2 °F	59.9 %	57.6 °F
MZU-1	ZN 1-01 (Rm 1130)	72.5 °F	61.7 %	58.6 °F
MZU-1	ZN 1-02 (Rm 1130 Storage)	73.5 °F	59.4 %	58.6 °F
MZU-2	ZN 2-02 (Corridor)	74.6 °F	59.4 %	59.6 °F
MZU-2	ZN 2-10 (Rm 1119)	72.2 °F	60.2 %	57.7 °F
MZU-3	ZN 3-02 (Rm 1134)	73.1 °F	58.4 %	58.0 °F
MZU-3	ZN 3-04 (Principal)	70.6 °F	55.5 %	56.3 °F
MZU-4	ZN 4-01 (Rm 1143)	72.5 °F	59.0 %	57.4 °F
MZU-4	ZN 4-03 (Rm 1155)	72.3 °F	58.8 %	57.1 °F



HVAC Graphic Sections Overview

Building Schedules

Elementary

Humidity Sensor Overview

Outdoor Air
DBT: 93.3 °F
DPT: 68.4 °F
WBT: 75.6 °F

Sensor Location	Dry-Bulb T (F)	RH (%)	Dew-Point T (F)	Scheduled Area	Serving CVB Click Me	Serving AHU Click Me	HVAC Plan Section Click Me
Room 501	73.0 °F	51.1 %	54.0 °F	A6	CVB-06-02	VAV AHU-06	HVAC Graphic Section A
Room 502	75.2 °F	46.8 %	53.4 °F	A6	CVB-06-04	VAV AHU-06	HVAC Graphic Section A
Room 410	73.4 °F	50.3 %	53.6 °F	A7	CVB-07-01	VAV AHU-07	HVAC Graphic Section A
Reception Office	74.1 °F	46.8 %	52.0 °F	A7	CVB-07-07	VAV AHU-07	HVAC Graphic Section A
Room 110	74.2 °F	48.1 %	53.4 °F	A8	CVB-08-01	VAV AHU-08	HVAC Graphic Section B
Room 105	74.3 °F	49.3 %	54.9 °F	A8	CVB-08-06	VAV AHU-08	HVAC Graphic Section B
Room 117	74.1 °F	49.6 %	54.0 °F	A9	CVB-09-01	VAV AHU-09	HVAC Graphic Section B
Room 119	72.5 °F	50.1 %	52.7 °F	A9	CVB-09-04	VAV AHU-09	HVAC Graphic Section B
Room 220 Corr	72.6 °F	49.4 %	52.5 °F	A10	CVB-10-03	VAV AHU-10	HVAC Graphic Section C
Room 222	73.1 °F	50.0 %	53.4 °F	A10	CVB-10-09	VAV AHU-10	HVAC Graphic Section C
Room 304	73.8 °F	50.3 %	54.0 °F	A12	CVB-12-01	VAV AHU-12	HVAC Graphic Section B
Room 303	73.4 °F	56.2 %	56.7 °F	A12	CVB-12-02	VAV AHU-12	HVAC Graphic Section B
Room 307	73.3 °F	50.6 %	53.8 °F	A13	CVB-13-01	VAV AHU-13	HVAC Graphic Section B
Room 308	73.5 °F	51.4 %	54.3 °F	A13	CVB-13-02	VAV AHU-13	HVAC Graphic Section B
Room 210	73.7 °F	56.8 %	57.3 °F	A15	CVB-15-01	VAV AHU-15	HVAC Graphic Section C
Room 207 Corr	73.5 °F	49.3 %	53.3 °F	A15	CVB-15-07	VAV AHU-15	HVAC Graphic Section C
Kitchen	74.4 °F	53.1 %	56.0 °F	A1		SZ AHU-01	HVAC Graphic Section A
Chiller Plant	78.3 °F	50.8 %	58.5 °F	A2		SZ AHU-02	HVAC Graphic Section A
Cafeteria	73.2 °F	54.9 %	55.8 °F	A3		SZ AHU-03	HVAC Graphic Section A
South Corridor	74.1 °F	53.0 %	55.8 °F	A4		SZ AHU-04	HVAC Graphic Section A
Gymnasium	73.5 °F	55.3 %	56.4 °F	A5		SZ AHU-05	HVAC Graphic Section A
Library	74.3 °F	52.2 %	55.6 °F	A11		SZ AHU-11	HVAC Graphic Section B
North Corridor	74.1 °F	52.4 %	55.5 °F	A14		SZ AHU-14	HVAC Graphic Section B

Exhaust Fan Overview

Exhaust Fan Overview is a table with additional interlock information that is typically not captured in the Area Served Overview. The required elements for this overview are:

Required Elements (Specification Requirements)

1. EF Name
2. EF Location
3. EF S/S
4. EF Status
5. EF Interlock Relationship (to OAHU, SF, Switch, Dishwasher, Kiln, etc.)

Example and Notes below are for clarification and illustrative purposes only and in no way does this information modify the required elements detailed above or in other areas of the Specifications

The screenshot examples below most closely capture the desired intent; although any/all examples may have some items in compliance with requirements and other items that are not.

Exhaust Fan Overview

GRAPHIC | STATUS

DBT : 91.9 °F
DPT : 69.8 °F
WBT : 76.0 °F
HVAC Emergency Shutdown: Normal

Elementary
Exhaust Fan Summary

HVAC Graphic Sections Overview
Building Schedules

Exhaust Fan	Space	Start/Stop	Status	Fan Current	Belt/Fan Failure	Interlock	Serving AHU Click Me	HVAC Plan Section Click Me
Exhaust Fan - 01	Room 616 Corr.	Start	Running	4.988 A	Normal	OAU-01	OAU-01	HVAC Graphic Section C
Exhaust Fan - 02	Mech. Mezz.	Start	Running	5.038 A	Normal	SF-11	VAV AHU-11	HVAC Graphic Section C
Exhaust Fan - 03	Kiln	Start	N/A	0.005 A	N/A	T-STAT	SZ AHU-12	HVAC Graphic Section C
Exhaust Fan - 04	Mech. Mezz.	Start	Running	5.028 A	Normal	SF-10	VAV AHU-10	HVAC Graphic Section B
Exhaust Fan - 05	Room 712	Stop	Stopped	0.005 A	In Alarm	SF-09	VAV AHU-09	HVAC Graphic Section B
Exhaust Fan - 06	Room 712 Corr.	Start	Stopped	0.005 A	In Alarm	SF-08	VAV AHU-08	HVAC Graphic Section B
Exhaust Fan - 07	Mech. Mezz.	Start	Running	2.700 A	Normal	SF-05	VAV AHU-05	HVAC Graphic Section B
Exhaust Fan - 08	Room 805 Corr.	Start	Running	2.204 A	Normal	SF-03	VAV AHU-03	HVAC Graphic Section A
Exhaust Fan - 09	Mech. Mezz.	Start	Running	5.134 A	Normal	SF-07	VAV AHU-07	HVAC Graphic Section B
Exhaust Fan - 10	Mech. Mezz.	Start	Running	5.098 A	Normal	SF-02	VAV AHU-02	HVAC Graphic Section A
Exhaust Fan - 11	Room K11	Start	Running	0.688 A	Normal	SF-01	VAV AHU-01	HVAC Graphic Section A
Exhaust Fan - 12	Mech. Mezz.	Start	Running	5.051 A	Normal	SF-04	VAV AHU-04	HVAC Graphic Section A
Exhaust Fan - 13	Kitchen	Stop	Stopped	0.003 A	Normal	OAU-02	OAU-02	HVAC Graphic Section C
Exhaust Fan - 14	Kitchen	Stop	Stopped	0.005 A	Normal	HOOD SWITCH	OAU-02	HVAC Graphic Section C
Exhaust Fan - 15	Kitchen	Stop	Stopped	0.005 A	Normal	HOOD SWITCH	OAU-02	HVAC Graphic Section C
Exhaust Fan - 16	Kitchen	Stop	Stopped	0.008 A	Normal	HOOD SWITCH	OAU-02	HVAC Graphic Section C
Exhaust Fan - 17	Room K10	Start	Running	0.858 A	Normal	VAV AHU-04	VAV AHU-04	HVAC Graphic Section A
Exhaust Fan - 18	Central Plant	Stop	Stop	N/A	N/A	Refrigerant	N/A	HVAC Graphic Section C
Exhaust Fan - 19	Room 601	Start	Stopped	0.006 A	In Alarm	SF-11	VAV AHU-11	HVAC Graphic Section C
Exhaust Fan - 20	Mech. Mezz.	Start	Running	4.966 A	Normal	SF-04	VAV AHU-04	HVAC Graphic Section A

IDF Supply Fan	Space	Start/Stop	Fan Current	Interlock	HVAC Plan Section Click Me
Supply Fan - 06	IDF Room 701	Stop	0.006 A	T-STAT	HVAC Graphic Section B
Supply Fan - 12	IDF Room 708	Start	0.011 A	T-STAT	HVAC Graphic Section B

EXHAUST FANS

TAG	FAN STATUS	LOCATION	START/STOP	INTERLOCK
EF-1	OFF	Mens S57W	STOP	SF-1
EF-2	OFF	Lounge S57V	STOP	SF-1
EF-3	OFF	Toilet S59L	STOP	SF-1
EF-4	OFF	Boys S20B	STOP	SF-1
EF-5	OFF	Boys S54D	STOP	SF-2
EF-6	OFF	Girls S40C	STOP	SF-2
EF-7	OFF	Toilet S55K	STOP	SF-4
EF-8	OFF	Toilet S55E	STOP	SF-4
EF-9	OFF	Womens S55T	STOP	SF-4
EF-12	OFF	Kitchen	STOP	HOOD/Dishwasher
EF-13	OFF	Locker S55Y	STOP	AHU-6
EF-14	*Unknown	Girls S70G	*Unknown	SF-7
EF-S1	OFF	Girls S113	STOP	SF-S1
EF-S2	OFF	KILN Room S128	STOP	KILN SWITCH
EF-S3	OFF	COMM S111	STOP	T-STAT

	S/S	Status	Interlock		S/S	Status	Interlock
EF-1	Off	Off	VAV AHU 2	SF-5 (Central Plant)	On	Off	LVS
EF-2	Off	Off	VAV AHU 2	SF-6 (Kiln)		Off	Switch
EF-3	Off	Off	VAV AHU 2	KEF/KSF-1	Off		SZ AHU-6 (Kitchen)
EF-4	Off	Off	VAV AHU 1	KEF-1		Off	
EF-5	Off	Off	VAV AHU 1	KSF-1		Off	
EF-6	Off	Off	VAV AHU 1	KEF/KSF-2	Off		SZ AHU-6 (Kitchen)
EF-7	Off	Off	VAV AHU 3	KEF-2		Off	
EF-9	Off	Off	VAV AHU 3	KSF-2		Off	
EF-10	Off	Off	VAV AHU 4	EF-3 (Dishwasher)	Off	Off	Dishwasher
EF-11	Off	Off	FCU-1A (Reception)				
EF-12	Off	Off	VAV AHU 4				
EF-13	Off	Off	VAV AHU 4				
EF-14	Off	Off	VAV AHU 3				
EF-15	Off	Off	BAS				
EF-16	Off	Off	BAS				
EF-17	Off	Off	BAS				
EF-18	Off	On	SZ AHU-6 (Kitchen)				

Miscellaneous Equipment Overview
Miscellaneous Equipment Overview is a table containing information for points in the BMCS that have not been accounted for in any other summary table. Due to the large number of possible points that may be monitored by the BMCS, it is not possible to list all required items, so required elements are based on defining principles for this overview.

Required Elements (Specification Requirements)
1. Point Name/Description
2. Point Value

Example and Notes below are for clarification and illustrative purposes only and in no way does this information modify the required elements detailed above or in other areas of the Specifications
The screenshot examples below most closely capture the desired intent; although any/all examples may have some items in compliance with requirements and other items that are not.

WoodCreek JUNIOR HIGH

MISC POINTS

Point	Value
Freezer Temperature	14.9 °F
Cooler Temperature	37.9 °F
Library Space Humidity	58.7 %RH
Outside Air Shutdown	NORMAL
IDF RM 1120	77.9 °F
IDF RM 1165A	77.8 °F
IDF RM 1172A	76.6 °F
IDF RM 2029	73.5 °F
IDF RM 1005	78.2 °F

DBT : 91.9 °F
DPT : 69.6 °F
WBT : 75.9 °F

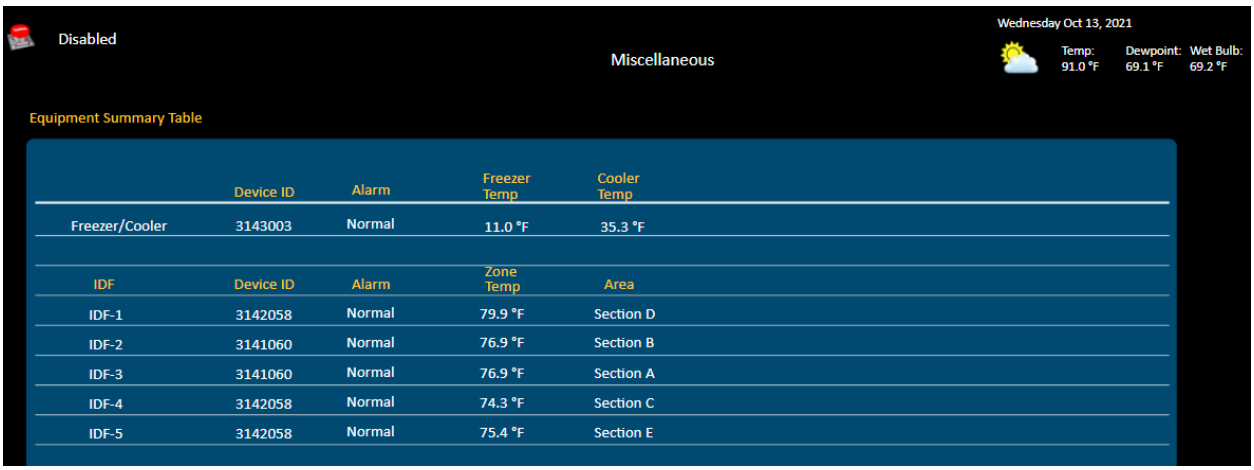
Elementary

HVAC Graphic Sections Overview

Building Schedules

Misc. Points Overview

Point Name	Current Value	Normal State/Setpoint	Space
HVAC Emergency Shutdown Status	Normal	Normal	SZ AHU-06
Cooler Temperature	37.9 °F	N/A	Kitchen
Freezer Temperature	1.6 °F	N/A	Kitchen
Library Space Humidity	59.2 %	N/A	Library
Gym Space Humidity	53.0 %	N/A	Gym
Cafeteria Humidity	61.3 %	N/A	Cafeteria
IDF Room 701 Temperature	72.6 °F	72.5 °F	Room 701
IDF Room 708 Temperature	78.7 °F	72.5 °F	Room 708
MDF Room 803 Temperature	72.6 °F	72.5 °F	Room 802



END OF SECTION 230994

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SECTION 232113 - ABOVE GROUND HYDRONIC PIPING

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

B. Section 230200 - Basic Materials and Methods for HVAC shall be included as a part of this Section as though written in full in this document.

1.2 WORK INCLUDED

A. Pipe and pipe fittings.

B. Flanges, unions, dielectric connections, and couplings.

C. Valves.

D. Heating water piping system.

E. Chilled water piping system.

F. Condensate drain piping.

1.3 RELATED WORK

A. Section 230516 - Expansion Fittings and Loops for HVAC Piping

B. Section 230529 - Hangers and Supports for Piping and Equipment - HVAC

C. Section 230548 - Vibration and Seismic Controls for HVAC Piping and Equipment

D. Section 230553 - Identification for HVAC Piping and Equipment

E. Section 230719 - HVAC Piping Insulation

F. Section 232116 - Underground Hydronic Piping

G. Section 232119 - Hydronic Specialties

1.4 REFERENCES

A. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250; 2020.

B. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300; 2021.

C. ASME B16.23 - Cast Copper Alloy Solder Joint Drainage Fittings: DWV; 2021.

D. ASME B16.29 - Wrought Copper and Wrought Copper Alloy Solder-Joint Drainage Fittings—DWV; 2022.

E. ASME B31.1 - Power Piping; 2024.

F. ASME B31.3 - Process Piping; 2022, with Errata (2023).

G. ASME B31.9 - Building Services Piping; 2020.

H. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators; 2023.

I. ASSE 1079 - Performance Requirements for Dielectric Pipe Unions; 2012.

J. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service; 2023a.

K. ASTM B32 - Standard Specification for Solder Metal; 2020.

L. ASTM B306 - Standard Specification for Copper Drainage Tube (DWV); 2020.

M. ASTM B828 - Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings; 2023.

N. ASTM D1384 - Standard Test Method for Corrosion Test for Engine Coolants in Glassware; 2005.

O. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2022.

P. ASTM F1476 - Standard Specification for Performance of Gasketed Mechanical Couplings for Use in Piping Applications; 2007 (Reapproved 2019).

Q. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2023).

R. ISO 9001 - Quality Management Systems — Requirements; 2015, with Amendment (2024).

S. ANSI/AWWA C110 - Ductile-Iron and Gray-Iron Fittings 3 in. through 48 in., for Water and Other Liquids.

T. ASTM A123 - Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

U. ASTM B32 - Solder Metal.

V. ASTM B88 - Seamless Copper Water Tube.

1.5 QUALITY ASSURANCE

A. Foreign made pipes and fittings will not be acceptable.

B. Valves: Manufacturer's name and pressure rating marked on valve body.

C. Welding Materials and Procedures: Conform to ASME BPVC-IX and applicable state labor regulations.

D. Welder’s Certification: In accordance with ASME BPVC-IX.

1.6 SUBMITTALS

A. Submit product data under provisions of Division One.

B. Include data on pipe materials, pipe fittings, valves, and accessories.

C. Include welder’s certification of compliance with ASME BPVC-IX.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site under provisions of Division One.

B. Store and protect products under provisions of Division One.

C. Deliver and store valves in shipping containers with labeling in place.

D. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

E. Protect piping systems from entry of foreign materials by temporary covers, proper storage and dunnage, completing sections of the work, and isolating parts of completed system. Tape will not be allowed as an acceptable end cover.

PART 2 - PRODUCTS

2.1 CHILLED AND HEATING WATER PIPING

A. Steel Pipe: ASTM A53/A53M, Schedule 40, 0.375 inch wall for sizes 12 inch and over, black.

1. Fittings: ASME B16.3, malleable iron or ASTM A234/A234M, forged steel welding type fittings.
2. Joints: Threaded, or AWS D1.1/D1.1M, welded.

2.2 EQUIPMENT DRAINS AND OVERFLOWS

A. Steel Pipe: ASTM A53/A53M, Schedule 40 galvanized.

1. Fittings: Galvanized cast iron, or ASME B16.3 malleable iron.
2. Joints: Threaded or grooved mechanical couplings.

B. Copper Drainage Tubing: ASTM B306, DWV.

1. Fittings: ASME B16.23 cast copper alloy solder joint DWV fittings or ASME B16.29 wrought copper alloy solder joint DWV fittings.
2. Joints: Soldered joints made in accordance with ASTM B828 using ASTM B32 Alloy Grade Sn50/Pb50 solder.

2.3 FLANGES, UNIONS, DIELECTRIC CONNECTIONS, AND COUPLINGS

A. Pipe Size 2 Inches and Under: Provide 150 psi malleable iron unions for threaded ferrous piping; bronze unions for copper pipe, soldered joints.

B. Pipe Size Over 2 Inches: Provide 150 psi forged steel slip-on flanges for ferrous piping; bronze flanges for copper piping; 1/16 inch thick preformed neoprene bonded gasket.

C. Dielectric connections for pipe sizes 2 inches and under: Provide dielectric unions, rated at 180°F at 250 psi in compliance with ASSE 1079.

D. Dielectric connections for pipe sizes larger than 2 inches: Provide dielectric flanged pipe fittings, rated to 180°F at 175 psi in compliance with ASME B16.1.

E. Grooved mechanical pipe couplings, fittings, valves and other grooved components may be used as an option to welding, threading or flanged methods. All grooved components shall be of one manufacturer, and conform to local code approval and/or is listed by ASME B31.1, ASME B31.3, ASME B31.9, ASME, UL/ULC. FM, IAPMO or BOCA. Grooved end manufacturer to be ISO 9001 certified. Grooved couplings shall meet the requirements of ASTM F1476. Manufacturer shall be Victaulic, Anvil Gruvlok, or Shurjoint. It can be utilized only in mechanical rooms or cooling tower areas.

2.4 ACCEPTABLE MANUFACTURERS - VALVES

A. Milwaukee

B. Crane

C. Nibco

D. Apollo

E. Bray

F. Kitz

2.5 ACCEPTABLE MANUFACTURERS - VALVES (GROOVED ONLY)

A. Victaulic

B. Anvil Gruvlok

C. Shurjoint

2.6 GLOBE VALVES

A. Up to 2 Inches: Bronze body, bronze trim, rising stem and handwheel, inside screw, renewable stainless steel disc, threaded ends, with back seating capacity.

B. Over 2 Inches: Iron body, bronze trim, rising stem, hand wheel, OS&Y, plug-type disc, flanged ends, renewable seat and disc.

2.7 BALL VALVES

A. Up to 2 Inches: Bronze two-piece body, 600 PSI full port, stainless steel ball and stem, teflon seats and stuffing box ring, lever handle, and balancing stops, threaded ends.

B. Over 2 Inches: Cast steel body, chrome plated steel ball, teflon seat and stuffing box seals, lever handle, or gear drive hand wheel for sizes 10 inches (250 mm) and over, flanged.

C. Ball valves installed in insulated lines shall have stem extensions compatible with up to 2” of insulation. Extensions shall be non-metallic equal to Nibco “nib-seal”.

2.8 PLUG COCKS

A. Up to 2 Inches: Bronze body, bronze tapered plug, non-lubricated, teflon packing, threaded ends, with one wrench operator for every ten plug cocks.

B. Over 2 Inches: Cast iron body and plug, pressure lubricated, teflon packing, flanged ends, with wrench operator with set screw.

2.9 BUTTERFLY VALVES

A. Iron body, aluminum bronze or stainless steel disc, resilient replaceable seat for service to 180 degrees F lug or grooved ends, extended neck, infinite position lever handle with memory stop. Valve shall be rated at full working pressure with downstream flange removed in either direction.

2.10 SWING CHECK VALVES

A. Up to 2 Inches: Bronze 45 degree swing disc, threaded ends.

B. Over 2 Inches Iron body, bronze trim, 45 degree swing disc, renewable disc and seat, flanged or grooved ends.

2.11 SPRING LOADED CHECK VALVES

A. Iron body, bronze trim, stainless steel spring, aluminum bronze disc, threaded, grooved, wafer or flanged ends.

2.12 RELIEF VALVES

A. Bronze body, teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, capacities ASME certified and labeled.

PART 3 - EXECUTION

3.1 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and dirt on inside and outside before assembly.

C. Prepare piping connections to equipment with flanges or unions.

D. After completion, fill, clean, and treat systems.

E. Provide extended necks for all vents, thermometer wells, pressure gauge wells, pet cocks and pete’s plugs.

3.2 INSTALLATION

A. Route piping in orderly manner, plumb and parallel to building structure, and maintain gradient.

B. Install piping to conserve building space, and not interfere with use of space and other work.

C. Group piping whenever practical at common elevations.

D. Branch tap connections to piping mains shall be from the top of the pipe.

E. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Refer to Section 230516 - Expansion Fittings and Loops for HVAC Piping.

F. Provide clearance for installation of insulation, and access to valves and fittings.

G. Provide access where valves and fittings are not exposed. Coordinate size and location of access doors with Division 08.

H. Slope piping and arrange systems to drain at low points. Use eccentric reducers to maintain top of pipe level.

I. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welds.

J. Prepare pipe, fittings, supports, and accessories for finish painting. Refer to Division 09.

K. Install valves with stems upright or horizontal, not inverted.

L. All grooved components (couplings, fittings, valves, gaskets, and specialties) shall be of one manufacturer.

M. Grooved manufacturer shall provide on-site training for contractor's field personnel by a factory trained representative in the proper use of grooving tools, application of groove, and the product installation. Factory trained representative shall periodically visit the job site and inspect installation. Contractor shall remove and replace any improperly installed products.

3.3 APPLICATION

A. Use grooved mechanical couplings and fasteners only in mechanical rooms or cooling tower area.

B. Install unions downstream of valves, and at equipment or apparatus connections.

C. Provide non-conducting dielectric connections wherever joining dissimilar metals.

D. Install brass male adapters each side of valves in copper piped system. Sweat solder adapters to pipe.

E. Install ball valves for shut-off and to isolate equipment, part of systems, or vertical risers.

F. Install plug valves for throttling, bypass, or manual flow control services.

G. Provide spring loaded check valves on discharge of condenser and chilled water pumps.

H. Use plug cocks for throttling service. Use non-lubricated plug cocks only when shut-off or isolating valves are also provided.

I. Use lug end butterfly valves to isolate equipment.

J. Provide chain operated butterfly valve for installations at 12 feet or higher.

K. Provide 3/4-inch ball (drain) valves equal to Nibco T-585-70-HC at main shut-off valves, low points of piping, bases of vertical risers, and at equipment and pipe to nearest drain.

L. Provide automatic air vents at all high points and air pockets in the system.

M. Gate valves shall ***not*** be installed in any chilled or hot water piping systems.

3.4 CONDENSATE DRAIN PIPING

A. Drain piping from each unit shall be extended to the nearest floor drain or condensate drainage system. Drains shall be of the size indicated but not less than the full size of the drain pan connections.

B. Use plugged tees in lieu of elbows.

C. Slope all drain lines 1/8" per foot, minimum.

D. Provide auxiliary drain pan on all AHU's above ceiling with auxiliary drain line routed to discharge in visually prominent area. Discharge location shall be coordinated with Architect.

3.5 PIPE FABRICATION AND INSTALLATION

A. All pipes shall be cut accurately to measurements established at the site and shall be worked into place without springing or forcing.

B. Piping layout and installation shall be made in the most advantageous manner possible with respect to headroom, valve access, opening and equipment clearance, and clearance from other work. Particular attention shall be given to piping in the vicinity of equipment; layout shall be made in such manner as to preserve maximum access to the various equipment parts for maintenance.

C. All changes in directions shall be made with fittings; field bending and mitering of pipe is prohibited.

D. Air vents and air chambers shall be installed as hereinafter specified.

3.6 OFFSETS AND FITTINGS

A. Due to the small scale of the Drawings, it is not possible to indicate all offsets, fittings, etc. which may be required. The Contractor shall carefully investigate structural and finish conditions affecting the Work and shall take such steps as may be required to meet such conditions at no additional cost to the Owner.

B. All piping shall be installed close to walls, ceilings and columns, (consistent with the proper space for covering, removal of pipe and special clearances), so as to occupy the minimum of space, and all offsets, fittings, etc., required shall be provided at no additional cost to the Owner.

3.7 SECURING AND SUPPORTING

A. All piping shall be adequately supported to line and grade, with due provisions for expansion and contraction.

B. Piping shall be supported on approved clevis type, split ring, or trapeze type hangers properly connected to the structural members of the building.

C. All insulated piping shall be fitted with suitable steel protection saddles.

D. Perforated bar hangers, straps, wire or chains will not be permitted.

3.8 ISOLATION VALVES

A. All piping systems shall be provided with line size shut-off valves located at risers, at branch connections to mains, and at other locations as indicated and required.

3.9 TESTING OF PIPING SYSTEMS

A. During the progress of the Work and upon completion, tests shall be made as specified herein and as required by Authorities Having Jurisdiction, including Inspectors, Owner or Engineer. The Engineer or duly authorized Construction Inspector shall be notified in writing at least 2 working days prior to each test or other Specification requirement which requires action on the part of the Construction Inspector.

B. Tests shall be conducted as part of this Work and shall include all necessary instruments, equipment, apparatus, and service as required to perform the tests with qualified personnel. Submit proposed test procedures, recording forms, and test equipment for approval prior to the execution of testing.

C. Tests shall be performed before piping of various systems have been covered or furred-in. For insulated piping systems, testing shall be accomplished prior to the application of any insulation.

D. All piping systems shall be tested and proved absolutely tight for a period of not less than 24 hours at a pressure of 150 psi(g) or 150% of design pressure, whichever is greater. Tests shall be witnessed by the Engineer or an authorized representative and pronounced satisfactory before pressure is removed or any water drawn off.

E. Leaks, damage or defects discovered or resulting from test shall be repaired or replaced to a like new condition. Leaking pipe joints, or defective pipe, shall be removed and replaced with acceptable materials. Test shall be repeated after repairs are completed and shall continue until such time as the entire test period expires without the discovery of any leaks, damage, or defects.

F. Wherever conditions permit, each piping system shall thereafter be subjected to its normal operating pressure and temperature for a period of no less than five 5 days. During that period, it shall be kept under the most careful observation. The piping systems must demonstrate the propriety of their installation by remaining absolutely tight during this period.

3.10 PIPE CLEANING, FLUSHING AND PURGING REQUIREMENTS AND PROCEDURES

A. The hydronic system shall be flushed and purged by contractor:

1. All mains, branches and zones shall be cleaned and treated per steps indicated below.

2. Owner/Engineer shall be given 72-hour notice prior to each step being performed.

B. Pre-flush requirements: Purpose is to get system ready for flushing and purging:

1. Piping must pass all required pressure testing and visual inspection for leaks.
2. All pumps shall be tested for rotation and properly aligned and lubricated.
3. Chemicals planning on being used must have certificate of assurance and product cut sheets presented to the owner/engineer prior to being used. All chemicals must be approved by the state prior to being added to the system, FDA approved and meet ASTM D1384. Automotive grade chemicals are not allowed.
4. Bypass all coils and heat exchangers by connecting the supply and return piping together.
5. Fill entire system with clean fresh potable water.

C. The flush requirements: Purpose is to completely remove all debris, dirt and air from hydronic system.

1. Add system cleaner that contains detergent and emulsifying agents to properly remove grease, grime and other debris for steel pipe. Volume of cleaner used shall be about 10% of total volume.
2. System shall be circulated for a minimum of 48 hours with water velocities of a minimum of 5 ft/sec or greater. After completed all strainers shall be removed and cleaned thoroughly. House pumps are acceptable to circulate water. House pumps or pump seals that are damaged during the flushing process shall be replaced at no cost to the Owner.
3. The system shall be entirely drained and flushed out to remove all of the cleaner from the system as quickly as possible after cleaning to prevent debris from settling. All strainers shall be removed and thoroughly cleaned after no more dirt and cleaner is visible in the flushing water as it leaves the system.

D. Final fill:

1. All air vents shall be opened to allow air to escape during filling.
2. Reconnect all flex connections to equipment.
3. System shall be drained and filled with a local domestic/softened water mixture as required by chemical treatment supplier. System shall be filled with pressure reducing valve at the specified fill pressure.

E. Purging: Purpose is to remove all air from the system:

1. System shall be circulated for a minimum of one hour with water velocities of a minimum of 5 ft/sec or greater until all visible air is removed.

F. Final chemical addition: Purpose is to install chemicals during inhibitor as required:

1. After the above final fill and purging has been completed and accepted by the engineer/owner the final chemical addition can be done.
2. Chemical treatment shall be added to the system after thoroughly mixing water per the manufacturer’s recommendations. Chemical treatment shall include inhibitors. Quantities and concentrations of inhibitor/chemicals should be applied per the manufacturer’s specifications and approval submittals.

3. System water shall be tested for chemical inhibitor concentrations, reserve alkalinity and PH. Reports shall be submitted to engineer/owner.
4. All records and documentation shall be kept and given to the owner upon completion.

END OF SECTION 232113

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SECTION 232119 - HYDRONIC SPECIALTIES

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

B. Section 230200 - Basic Materials and Methods for HVAC shall be included as a part of this Section as though written in full in this document.

1.2 WORK INCLUDED

A. Air vents.

B. Strainers.

C. Flow indicators, controls, meters.

D. Radiator valves.

E. Relief valves.

F. Pressure and temperature test plugs.

1.3 RELATED SECTIONS

A. Section 232113 - Above Ground Hydronic Piping

B. Section 232116 - Underground Hydronic Piping

C. Section 232123 - Hydronic Pumps

D. Section 230529 - Hangers and Supports for Piping and Equipment - HVAC

1.4 REFERENCES

A. ASME BPVC-VIII-1 - Boiler and Pressure Vessel Code, Section VIII, Division 1: Rules for Construction of Pressure Vessels; 2023.

1.5 QUALITY ASSURANCE

A. Manufacturer: For each product specified, provide components by same manufacturer throughout.

B. Conform to ASME BPVC-VIII-1 for manufacturer of tanks.

1.6 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data under provisions of Division One.

B. Include installation instructions, assembly views, lubrication instructions, and replacement parts list.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site under provisions of Division One.

B. Store and protect products under provisions of Division One.

1.8 OPERATIONS PERSONNEL TRAINING

A. Provide a training session for the owner’s operations personnel. Training session shall be performed by a qualified person who is knowledgeable in the subject system/equipment. Submit a training agenda two (2) weeks prior to the proposed training session for review and approval. Training session shall include at the minimum:

1. Purpose of equipment.
2. Principle of how the equipment works.
3. Important parts and assemblies.
4. How the equipment achieves its purpose and necessary operating conditions.
5. Most likely failure modes, causes and corrections.
6. On site demonstration.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS - AIR VENTS

A. Armstrong.

B. Bell and Gossett/ITT Hoffman.

C. IMI Flow Design.

2.2 AIR VENTS

A. Manual Type: Short vertical sections of 2 inch diameter pipe to form air chamber, with 1/8 inch brass needle valve at top of chamber.

B. Float Type: Brass or semi-steel body, copper float, stainless steel valve and valve seat; suitable for system operating temperature and pressure; with isolating valve.

C. Washer Type: Brass with hydroscopic fiber discs, vent ports, adjustable cap for manual shut-off, and integral spring loaded ball check valve.

2.3 ACCEPTABLE MANUFACTURERS - STRAINERS

A. Armstrong.

B. Bell and Gossett.

C. IMI Flow Design.

D. Mueller Steam Specialty.

2.4 ACCEPTABLE MANUFACTURERS - STRAINERS (GROOVED ONLY)

A. Victaulic

B. Anvil Gruvlok

C. Shurjoint

2.5 STRAINERS

A. Size 2 inch and Under: Threaded brass or iron body for 175 psig working pressure, Y pattern with 1/32 inch stainless steel perforated screen.

B. Size 2-1/2 inch to 4 inch: Flanged or grooved iron body for 175 psig working pressure, Y pattern with 3/64 inch stainless steel perforated screen.

C. Size 6 inch and Larger: Flanged or grooved iron body for 175 psig working pressure, basket pattern with 1/8 inch stainless steel perforated screen.

2.6 ACCEPTABLE MANUFACTURERS - FLOW INDICATORS

A. Bell and Gossett.

B. Watson McDaniel.

2.7 FLOW INDICATORS

A. Brass construction, threaded for insertion into piping system, packless, with paddle with removable segments, vapor proof electrical compartment with switches.

2.8 ACCEPTABLE MANUFACTURERS - FLOW CONTROLS

A. Bell and Gossett/ITT Hoffman.

B. IMI Flow Design.

C. TACO.

D. Victaulic/TA

2.9 FLOW CONTROLS

A. Construction: Brass or bronze body with union on inlet and outlet, temperature and pressure test plug on inlet, and outlet, blowdown/backflush drain.

B. Calibration: Control flow within 5 percent of selected rating, over operating pressure range of 10 times minimum pressure required for control.

C. Control Mechanism: Stainless steel or nickel plated brass piston or regulator cup, operating against stainless steel helical or wave formed spring.

D. Accessories: In-line strainer on inlet, and ball valve on outlet.

2.10 ACCEPTABLE MANUFACTURERS - FLOW METERS

A. Bell and Gossett/ITT Hoffman.

B. IMI Flow Design.

C. TACO.

D. Victaulic/TA.

2.11 FLOW METERS

A. Orifice principle by-pass circuit with direct reading gauge, soldered, or flanged piping connections for 125 psig working pressure, with shut off valves, and drain and vent connections.

B. Cast iron, wafer type, orifice insert flow meter for 250 psig working pressure, with read-out valves equipped with integral check valves with gasketed caps.

C. Calibrated, plug type balance valve with precision machined orifice, readout valves equipped with integral check valves and gasketed caps, calibrated nameplate and indicating pointer.

D. Cast iron or bronze, globe style, balance valve with handwheel with vernier type ring setting and memory stop, drain connection, readout valves equipped with integral check valves and gasketed caps.

E. Portable meter consisting of case containing two, 3 percent accuracy pressure gauges with 0-135 inches and 0-60 feet pressure ranges for 500 psig maximum working pressure, color coded hoses for low and high pressure connections, and connectors suitable for connection to read-out valves.

2.12 ACCEPTABLE MANUFACTURERS - RELIEF VALVES

A. Bell and Gossett.

B. McDonnell-Miller.

C. TACO.

2.13 RELIEF VALVES

A. Bronze body, teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, capacities ASME certified and labelled.

2.14 ACCEPTABLE MANUFACTURERS - PRESSURE AND TEMPERATURE TEST PLUGS

A. Peterson Equipment Company

2.15 PRESSURE AND TEMPERATURE TEST PLUGS

A. Test plugs shall be designed to receive temperature or pressure probe. Plugs shall be solid brass with two valve cores of Neoprene (Max 200°F service), fitted with removable protective cap, cap retaining strap, and gasket. Provide plugs with extension neck to match pipe insulation thickness.

PART 3 - EXECUTION

3.1 INSTALLATION AND APPLICATION

A. Install specialties in accordance with manufacturer`s instructions to permit intended performance.

B. Where large air quantities can accumulate, provide enlarged air collection standpipes.

C. Provide manual air vents at system high points and as indicated on details and drawings.

D. For automatic air vents in ceiling spaces or other concealed locations, provide vent tubing to nearest drain.

E. Provide valved drain and hose connection on strainer blow down connection.

F. Provide relief valves on pressure tanks; and on low pressure side of reducing valves, heat exchangers, and expansion tanks.

G. Select system relief valve capacity so that it is greater than make-up pressure reducing valve capacity. Select equipment relief valve capacity to exceed rating of connected equipment.

H. Pipe relief valve outlet to nearest floor drain.

I. Where one line vents several relief valves, make cross sectional area equal to sum of individual vent areas.

J. Provide pressure and temperature test plugs at the inlet and outlet of all coils, coil control valves, heat exchangers, strainers, pumps, and at all other locations indicated on the drawings.

END OF SECTION 232119

SECTION 232300 - REFRIGERANT PIPING

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

B. Section 230200 - Basic Materials and Methods for HVAC shall be included as a part of this Section as though written in full in this document.

1.2 SCOPE

A. Scope of the Work shall include the furnishing and complete installation of the equipment covered by this Section, with all auxiliaries, ready for Owner's use.

1.3 REFERENCES

A. AHRI 710 - Performance Rating of Liquid-Line Driers; 2009.

B. AHRI 730 (I-P) - Flow Capacity Rating of Suction Line Filters and Suction Line Filter Driers; 2013 (Reapproved 2014).

C. ASHRAE Std 15 - Safety Standard for Refrigeration Systems; 2022, with Addendum (2024).

D. ASHRAE Std 34 - Designation and Safety Classification of Refrigerants; 2022, with Errata (2024).

E. ASHRAE Std 147 - Reducing the Release of Halogenated Refrigerants from Refrigerating and Air-Conditioning Equipment and Systems; 2019, with Addendum (2024).

F. ASME A13.1 - Scheme for the Identification of Piping Systems; 2023.

G. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2021.

H. ASME B31.5 - Refrigeration Piping and Heat Transfer Components; 2022.

I. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators; 2023.

J. ASTM B280 - Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service; 2023.

K. AWS A5.8M/A5.8 - Specification for Filler Metals for Brazing and Braze Welding; 2019.

L. AWS B2.2/B2.2M - Specification for Brazing Procedure and Performance Qualification; 2016.

1.4 SUBMITTALS

A. Shop Drawings: Indicate layout of refrigeration piping system, including equipment, critical dimensions, and sizes.

B. Piping: Submit data on pipe materials, fittings, and accessories.

C. Valves: Submit manufacturers catalog information with valve data and ratings for each service.

D. Refrigerant Specialties: Submit manufacturers catalog information including capacity, component sizes, rough-in requirements, and service sizes.

E. Welding Certificates: Submit per AWS B2.2/B2.2M and ASME BPVC-IX.

PART 2 - PRODUCTS

2.1 GENERAL

A. Provide for the systems as shown. Submit shop drawings of piping systems showing all traps, pipe sizes, and accessories; drawing to be marked "Approved" and signed by a representative of the Application Engineering Department of the condensing unit manufacturer. Pipe sizes shall be as recommended by unit manufacturer. Refer to piping schematic on Drawings.

2.2 MATERIAL

A. PIPE: Type ACR copper tubing, hard-drawn, per ASTM B280.

B. FITTINGS: Wrought copper per ASME B16.22.

C. JOINTS: Brazed joints with Sil-Fos filler metal per AWS A5.8M/A5.8.

2.3 ACCESSORIES

A. All accessories shall be UL listed and rated in accordance with AHRI 710.

B. On systems 7-1/2 tons and larger, each separate refrigerant circuit shall have a separate filter drier rated in accordance with AHRI 730 (I-P). Each filter drier shall have a replaceable core and a three valve bypass. The filter drier shall be full line size and installed in the refrigerant liquid line. The filter shall have a minimum 4-3/4 inches diameter shell with removable flange and gasket. Flange shall be tapped for 1/4 inch FPT access valve. Size filter-drier for maximum 2.0 psi pressure drop at evaporator operating temperature. Similar to Mueller Refrigeration model Drymaster micro-guard refillable filter series SD-485 through SD19217 or Sporlan catch-all.

C. On systems less than 7-1/2 tons, the filter drier shall be the sealed type, sizes as above. One drier per refrigerant circuit.

D. Liquid-Moisture Indicator shall be full line size, installed in liquid refrigerant line. Indicator shall be rated for the applicable refrigerant, system pressure and temperature; manufactured by Mueller Refrigeration or Sporlan.

E. Thermostatic expansion valve shall have adjustable super heat and be as manufactured by Sporlan.

F. Shut-off valves shall be bi-directional ball valves with welded body, brass ball with dual Teflon seals and integral relief port. Valves shall be rated for the applicable refrigerant, system pressure and temperature. Valves shall be manufactured by Mueller Refrigeration or Sporlan.

2.4 REFRIGERANT AND OIL

A. Contractor shall leave the refrigeration system with a full charge of refrigerant and oil and shall be responsible for the maintenance of a full charge of refrigerant and oil in the systems for a period of one year from date of Substantial Completion.

B. Should any leaks in the refrigeration system occur during the guarantee period, the Contractor shall eliminate such leaks and recharge system to a full charge of refrigerant and oil at no cost to the Owner.

PART 3 - EXECUTION

3.1 INSTALLATION

A. All equipment and piping shall be installed in accordance with the manufacturer’s recommendations and printed installation instructions.

B. All items required for a complete and proper installation are not necessarily indicated on the Drawings or in the Specifications. Provide all items required as per manufacturer’s requirements.

C. Refrigerant piping shall be installed in accordance with ASHRAE Std 15 and ASHRAE Std 34.

D. Arrange refrigerant piping to return oil to compressor. Provide traps and loops in piping, and provide double risers as required.

E. Braze joints per AWS B2.2/B2.2M and AWS A5.8M/A5.8 requirements.

F. Pipe shall be cut square, reamed and chamfered, and shall be free from burrs and obstruction. Pipe ends shall have full-bore openings and shall not be undercut.

G. Refrigerant piping located in areas other than the room or space where the refrigerating equipment is located shall be identified with pipe markers that meet labeling requirements of

ASME A13.1. Markers shall be manufactured by W.H. Brady Company or approved equal. The pipe identification shall be located at intervals not exceeding 20 feet on the refrigerant piping or pipe insulation. The minimum height of the identification lettering shall be 1/2". The pipe identification shall indicate the refrigerant designation and safety group classification of the refrigerant used in the piping system. For Group A2, A3, B2, and B3 refrigerants, the identification shall also include the following statement: “DANGER – Risk of Fire or Explosion. Flammable Refrigerant.” For any Group B refrigerant, the identification shall also include the following statement: “DANGER – Toxic Refrigerant.”

H. Refrigerant piping routed indoors shall be installed at a minimum of 7’-3” above finished floor when located above an area affording passage of occupants.

I. Refrigerant piping located indoors shall be located within building elements such as a ceiling or wall space or within a protective enclosure unless installed a minimum of 7’-3” above finished floor, within 6’-0” of the associated equipment or within a refrigerant machinery room.

J. Provide shield plates for refrigerant pipes containing Group A2L and B2L refrigerants that are located in concealed locations where piping is installed in studs, joists, rafters or similar member spaces, and are located less than 1-1/2 inches from the nearest edge of the member. Shield plates shall have a minimum thickness of 16 gage and shall extend two inches beyond the edge of the piping on each side.

K. Refrigerant pipe and joints installed in the field shall be exposed for visual inspection and testing prior to being covered or enclosed.

3.2 FIELD QUALITY CONTROL

A. Test piping and refrigeration system in accordance with ASME B31.5, ASHRAE Std 147, and this section.

B. The refrigerant piping system shall be tested as a whole, or separate tests shall be conducted for the low-pressure side and high-pressure side of the piping system.

1. Pressure Test:

a. Pressure test shall be performed using dry nitrogen.
b. The means used to pressurize the refrigerant piping system shall have on its outlet side a test pressure measuring device and either a pressure-limiting device or a pressure-reducing device. The test pressure measuring device shall have an accuracy of +/- 3% or less of the test pressure and shall have a resolution of 5% or less of the test pressure.
c. The system shall be pressurized for a period of not less than 60 minutes. Additional test gas shall not be added to the system after the start of the test.
d. Test pressure shall be at least 110% of the system design pressure.
e. Test pressure shall not exceed 130% of the design pressure of any component in the system.
f. The system shall not show loss of pressure on the on the test measuring device throughout the entirety of the test.

2. Evacuation and Leak Test:

    a. Evacuate moisture completely by applying a commercial vacuum pump. Moisture indicator shall indicate a completely moisture-free condition at time of final inspection.
    b. The vacuum pump shall run until the system indicates a vacuum of 500 microns.
    c. After achieving a vacuum, the system shall be isolated from the vacuum pump. The system pressure shall not rise for a minimum of 24 hours.
    d. The system shall be flushed with the operating refrigerant and the vacuum pump connected and rerun to repeat the evacuation. Evaluation shall be performed under supervision of the Engineer.

C. Repair any and all leaks and retest as required.

END OF SECTION 232300

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SECTION 232513 - WATER TREATMENT FOR CLOSED LOOP HYDRONIC SYSTEMS

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

B. Section 230200 - Basic Materials and Methods for HVAC shall be included as a part of this Section as though written in this document.

1.2 SCOPE

A. Scope of the Work shall include the furnishing and complete installation of the equipment covered by this Section, with all auxiliaries, ready for Owner’s use.

1.3 REFERENCES

A. ASTM D596 - Standard Guide for Reporting Results of Analysis of Water; 2018.

B. ASTM D1067 - Standard Test Methods for Acidity or Alkalinity of Water; 2016.

C. ASTM D1068 - Standard Test Methods for Iron in Water; 2015.

D. ASTM D1126 - Standard Test Method for Hardness in Water; 2017.

E. ASTM D3370 - Standard Practices for Sampling Water from Flowing Process Streams; 2018.

1.4 DESCRIPTION OF WORK

A. Work Included: Perform water analysis and provide all water treatment products, equipment and labor for testing, cleaning, flushing and dispensing products to control water quality for each system specified hereinafter as follows:

1. Chilled Water System
2. Hot Water System

B. Chemicals: Provide, at no additional cost to the Owner, all chemicals required for operating and testing all water treatment systems prior to and for one (1) year after Substantial Completion.

C. Instructions: Provide operating and maintenance instructions for each water treatment system; include one set in each Owner’s Manual and deliver one set to Owner’s operating personnel.

D. Testing Equipment and Reagents: Furnish suitable water treatment testing equipment for each system, complete with apparatus and reagents necessary for operation prior to and for three (3) months after Substantial Completion.

1. Service Representative:

a. Cleaning and Flushing test required verifying satisfactory completion of pipe cleaning.
b. Provide water analysis report quarterly on each operating system.
c. Annually perform microbiological culture study on the system to monitor bacteria.

E. Replacement and Rework: Replace defective or nonconforming materials and equipment with new materials and equipment at no additional cost to Owner for one (1) year after Substantial Completion; monthly reports shall be provided to the Owner and Architect/Engineer.

1. Guarantee: Provide system produced by manufacturer who is willing to execute the required guarantee.

a. Agreement to Maintain: Provide system produced by manufacturer who is willing to execute (with the Owner) the required agreement for continued maintenance of the system.

1.5 QUALITY ASSURANCE

A. Qualifications: The Water Treatment Contractor for work under this Section shall have:

1. Research and development facilities.

a. Regional laboratories capable of making a water analysis.
b. A service department and qualified technical service representative located within a reasonable distance of the project site.
c. Service representatives who are Registered Engineers or factory-certified technicians with not less than five (5) years of water treatment experience with the water treatment system manufacturer. A Certified Water Technologist (CWT) qualified professional is preferred.

B. Packaging and Labeling: Water treatment chemicals will be supplied in a container suitable for product and will be in accordance with DOT shipping standards.

C. Electrical Standards: Provide electrical products which have been tested, listed and labeled by Underwriters Laboratories (UL) and which comply with National Electrical Manufacturers' Association (NEMA) standards.

D. Chemical Standards: Provide chemical products acceptable under state and local pollution control or other governing regulations.

1.6 SUBMITTALS

A. Test reports: Submit test reports certified by an officer of the firm, on water treatment company letterheads, of samples of each treated water system specified. Comply with ASTM D596 for reporting. Indicate the ASTM best methods for each test. Tests will included by are not limited to conductivity, pH, chemical residual, iron, copper, and bacteria count.

B. Shop Drawings: Submit shop drawings for each water treatment system. Show wiring, pumps, piping and tubing sizes, fittings, accessories, valves and connections and monitoring equipment.

C. Guarantee: Submit written guarantee, signed by the Manufacturer and countersigned by the Installer and Contractor, agreeing to adjust or replace the chemicals in the systems as required to achieve the required performance, during a one (1) year period following the final start-up or the continued operation of the systems.

D. Agreement to Maintain: Prior to the time of final acceptance, the Manufacturer of the water treating system shall submit four (4) copies of an "Agreement for Continued Service and the Owner's Possible Acceptance." Offer terms and conditions for furnishing chemical and providing continued testing and equipment for a one (1) year period with option for renewal of the Agreement by Owner.

1.7 OPERATIONS PERSONNEL TRAINING

A. Provide a training session for the owner's operations personnel. Training session shall be performed by a qualified person who is knowledgeable in the subject system/equipment. Submit a training agenda two (2) weeks prior to the proposed training session for review and approval. Training session shall include at the minimum:

1. Purpose of equipment.

a. Principle of how the equipment works.
b. Important parts and assemblies.
c. How the equipment achieves its purpose and necessary operating conditions.
d. Most likely failure modes, causes and corrections.
e. On site demonstration.

PART 2 - PRODUCTS

2.1 GENERAL

A. Water Analysis: Determine which chemicals to use from the results of a water sample analysis taken from the building site by the system manufacturer. Provide ingredients necessary to achieve the desired water conditions.

B. Pre-Treatment: Treat water piping systems with chemicals to remove and permit flushing of mill scale, oil, grease and other foreign matter.

C. FDA and USDA Approval: Use only FDA and USDA approved products in system with direct connection to domestic water systems.

D. Governing Laws: Ensure that neither products, waste, blow-down nor other effluents violate local, state, EPA, or other agency regulations in effect in the project area.

2.2 APPROVED WATER TREATMENT SERVICE

A. Water Treatment Services

B. Kurita (U.S. Water/ChemCal)

C. Chem Treat

D. Nalco

E. Garratt Callahan

2.3 CHILLED AND HOT WATER SYSTEMS

A. Chemicals: Provide water treatment products which contain inhibitors that perform the following:

1. Form a protective film to prevent corrosion and scale formation;
2. Scavenge oxygen and protect against scale;
3. Remain stable throughout operating temperature range, and;
4. Are compatible with pump seals and other elements in the system.
5. Corrosion inhibitor chemical – chill loop. This product must be in liquid form and impart the following active ingredients at the following dosages when fed in CHILL LOOP water: 1) nitrite (as NO2) = 400-800 ppm, 2) borate = 200-400 ppm, 3) azole = 20-60 ppm. The resulting bulk water pH range should be 9.0-10.5.
6. Corrosion inhibitor chemical – hot loop. This product must impart the following active ingredients at the following dosages when fed in HOT LOOP water: 1) nitrite (as NO2) = 800-1200 ppm, 2) borate = 400-600 ppm, 3) azole = 40-80 ppm. The resulting bulk water pH range should be 9.0-10.5., for aluminum condensing boiler molybdate at 10 to 25 ppm.

B. Equipment: For each system, provide a 5-gallon filter feeder constructed of materials which are impervious to the products dispensed. Feeder shall be designed for not less than 200-psig operating pressure. Filter feeder shall be as manufactured by Vector Industries model FA-900 or approved equal. Provide flow indicator meter on discharge of filter feeder.

C. Test Kit: Provide test kit and reagents for determining proper water conditions. Test kit should be capable of testing presence of corrosion inhibitor and pH. A handheld connectivity/TDS meter shall be part of the test kit package.

D. Treatment: Treat initial water charge to water system, after system has been flushed and prepped, to achieve a water quality as specified. Test report required to verify cleaning.

E. Reports: Prepare certified test report for each required water performance characteristic. Comply with the following ASTM standard, where applicable:

1. ASTM D1067 – Tests for Acidity or Alkalinity of Water.
2. ASTM D1068 – Tests for Iron in Water and Waste Water.
3. ASTM D1126 – Tests for Hardness in Water.
4. ASTM D3370 – Sampling Water.

PART 3 - EXECUTION

3.1 THE WATER TREATMENT CONTRACTOR

A. General: After piping systems are erected pressure tested and proven free of leaks, administer chemicals required for preparation treatment and flushing. Apply chemicals for the time period and in the concentration recommended by the water treatment manufacturer for this portion of the work. Flushing must be for a minimum of 24 continuous hours.

B. Testing: After completion of 24 continuous hours of flushing, perform test procedures and submit a written report of test conditions and results to the Engineer. If test results are unsatisfactory, repeat preparation treatment as necessary to achieve test results approved by the Owner’s insurance carrier and the Engineer.

3.2 SERVICES OF MECHANICAL CONTRACTOR

A. Piping systems shall be pressure tested and approved for tightness, they shall be thoroughly cleaned and flushed using and approved pipe cleaning.

B. After initial chemical treatment has been added, the systems must be circulated for 48 hours with all valves opened; then the automated building system can be initiated.

3.3 PIPE CLEANING, STERILIZATION, AND FLUSHING

A. Additions/Renovations: When connecting new piping to existing piping, provide full size isolation valves at connection points and wire strainer with fine mesh screens.

B. All connections required for cleaning, purging and circulating shall be included as permanent installation with valves. Provide permanent pipe bypasses at each coil and heat exchanger during this cleaning operation and for future flushing. All air vents, gauges, strainers, etc., valved connections in piping systems shall be blown clean during cleaning and after cleaning operation is completed.

C. After cleaning, drain the system, fill with fresh water and flush thoroughly for a minimum of 48 hours or as recommended by Engineer.

D. All flushing, cleaning, and initial chemical treatment shall be complete and witnessed by Owner prior to starting systems.

E. Start-up procedures: During water system start-up, operate water treating system (after changing with specified chemicals) to maintain the required steady-state characteristics of water. Demonstrate system operation to Owner's operating personnel.

3.4 ADDITIONAL REQUIREMENTS FOR THE WATER TREATMENT CONTRACTOR

A. Vendor shall warrant the chemicals used in the water treatment program, and will have no detrimental effects on the metallic or non-metallic materials in the equipment being treated; if applied according to Vendor's instructions.

B. All testing of the Owner's systems are to be completed on-site and discussed with Owner's HVAC personnel with a copy of the report given to him/her for signature.

C. All work shall be performed in cooperation with Owner's HVAC personnel.

D. Periodic de-scaling with inhibited acids will not be considered as meeting this specification.

E. Sulfuric acid or other inhibited acids shall not be used in the chemical treatment program of Owner.

F. The Contractor shall provide a biocide program consisting of both an oxidizing biocide and bio-dispersant if required.

3.5 PERSONNEL TRAINING

A. Operator Training: Train Owner's personnel in use and operation of heating water, chilled water treating systems. A Program Administration Manual shall be furnished encompassing all systems in this section of the Specifications.

B. Provide two (2) hours in use and operation of water treating systems.

END OF SECTION 232513

SECTION 233113 - METAL DUCTWORK

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Low pressure ductwork.

B. Medium pressure ductwork.

C. Exposed ductwork located indoors.

D. Duct leakage testing.

E. Duct system protection.

F. Duct system cleaning.

1.2 RELATED SECTIONS

A. Division 9 - Finishes: Weld priming, weather resistant, paint or coating.

B. Section 230200 - Basic Materials and Methods for HVAC

C. Section 230529 - Hangers and Supports for Piping and Equipment - HVAC

D. Section 230593 - Testing, Adjusting, And Balancing

E. Section 230713 - Duct Insulation

F. Section 233300 - Ductwork Accessories

G. Section 233713 - Air Distribution Devices

1.3 REFERENCES

A. ASTM A480/A480M - Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip; 2023b.

B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.

C. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.

D. NADCA ACR - The NADCA Standard for Assessment, Cleaning, and Restoration of HVAC System; 2021.

E. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2020.

F. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors; Current Edition, Including All Revisions.

G. SMACNA (LEAK) - HVAC Air Duct Leakage Test Manual.

H. ASHRAE (FUND) ASHRAE Handbook - Fundamentals; Chapter 21 - Duct Design.

I. ASHRAE (HVACS) ASHRAE Handbook - HVAC Systems and Equipment; Chapter 19 - Duct Construction.

J. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings.

K. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems.

L. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.

M. ICC (IECC) - International Energy Conservation Code.

1.4 QUALITY ASSURANCE

A. Manufacturer’s Qualifications: Firms regularly engaged in manufacture of metal ductwork products of types, materials and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Installer’s Qualifications: Firms with least 3 years of successful installation experience on projects with metal ductwork systems similar to that required for project.

1.5 GENERAL DESCRIPTION

A. Extent of metal ductwork is indicated on drawings and in schedules, and by requirements of this section.

1.6 SUBMITTALS

A. Submit shop drawings, duct fabrication standards and product data under provisions of Division One.

B. Indicate duct fittings, particulars such as gauges, sizes, welds, and configuration prior to start of work.

C. The contract documents are schematic in nature and are to be used only for design intent. The contractor shall prepare sheet metal shop drawings, fully detailed and drawn to scale, indicating all structural conditions, all plumbing pipe and light fixture coordination, and all offsets and

transitions as required to permit the duct to fit in the space allocated and built. All duct revisions required as a result of the contractor not preparing fully detailed shop drawings will be performed at no additional cost.

1.7 DEFINITIONS

A. Duct Sizes: Inside clear dimensions. For lined ducts, maintain indicated clear size inside lining. Where offsets or transitions are required, the duct shall be the equivalent size based on constant friction rate.

B. Low Pressure: Low pressure ductwork shall be rated for an operating pressure of 2". Low pressure ductwork shall be defined as all return, exhaust, and outside air ducts, all supply ductwork associated with constant volume air handling units with a scheduled external static pressure of less than 2", and all supply ductwork downstream of terminal units in variable volume systems.

C. Medium Pressure: Medium pressure ductwork shall be rated for an operating pressure of 4". Medium pressure ductwork shall be defined as all supply ductwork extending from variable volume air handling units to terminal units in variable volume systems with air handling units having a scheduled external static pressure of less than 4". The supply ductwork of constant volume air handling units having a scheduled external static pressure greater than 2" and less than 4" shall be rated for medium pressure.

D. High Pressure: High pressure ductwork shall be rated for an operating pressure of 6", or the scheduled external pressure of the equipment it is connected to, whichever is greater. The supply ductwork of air handling units having a scheduled external static pressure greater than 4" shall be high pressure.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Protection: Protect shop-fabricated and factory-fabricated ductwork, accessories and purchased products from damage during shipping, storage and handling. Prevent end damage and prevent dirt and moisture from entering ducts and fittings, use sheet metal end caps on any lined duct exposed to the weather.

B. Storage: Where possible, store ductwork inside and protect from weather. Where necessary to store outside, store above grade and enclose with waterproof wrapping.

PART 2 - PRODUCTS

2.1 DUCTWORK MATERIALS

A. Exposed Ductwork Materials: Where ductwork is indicated to be exposed to view in occupied spaces, provide materials which are free from visual imperfections including pitting, seam marks, roller marks, stains and discolorations, and other imperfections, including those which would impair painting.

B. Sheet Metal: Except as otherwise indicated, fabricate ductwork from galvanized sheet steel complying with ASTM A653/A653M.

C. Stainless Steel Sheet: Where indicated, provide stainless steel complying with ASTM A480/A480M; Type 316; with No. 4 finish where exposed to view in occupied spaces, No. 1 finish elsewhere. Protect finished surfaces with mill-applied adhesive protective paper, maintained through fabrication and installation.

D. Aluminum Sheet: Where indicated, provide aluminum sheet complying with ASTM B209, Alloy 3003, Temper H14.

2.2 MISCELLANEOUS DUCTWORK MATERIALS

A. General: Non-combustible and conforming to UL 181, Class 1 air duct materials.

B. Flexible Ducts: Flexmaster U.S.A., Inc. Type 5M, Thermaflex MKE, ATCO #036 or approved equal.

1. Flexible ducts shall be corrosive resistant galvanized steel formed and mechanically locked to inner fabric with minimum 1-1/2" thick, R-6 insulation. Flexible duct shall be rated up to at least 10 in.w.g. positive pressure and shall have reinforced metalized outer jacket to comply with UL 181, Class 1 air duct.

C. Sealants: Hard-Cast “iron grip” or approved equal, non-hardening, water resistant, fire resistive and shall not be a solvent curing product. Sealants shall be compatible with mating materials, liquid used alone or with tape or heavy mastic.

D. Ductwork Support Materials: Except as otherwise indicated, provide hot-dipped galvanized steel fasteners, anchors, rods, straps, trim and angles for support of ductwork.

1. For exposed stainless steel ductwork, provide matching stainless steel support materials.
2. For aluminum ductwork, provide aluminum support materials.

2.3 LOW PRESSURE DUCTWORK

A. Fabricate and support in accordance with latest SMACNA (DCS) Standards and ASHRAE handbooks, except as indicated. Provide duct material, gauges, reinforcing, and sealing for operating pressures indicated.

B. Size round ducts installed in place of rectangular ducts in accordance with ASHRAE table of equivalent rectangular and round ducts. No variation of duct configuration or sizes permitted except by approved shop drawings. Obtain engineer’s approval prior to using round duct in lieu of rectangular duct.

C. Construct T's, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Where not possible and where rectangular elbows are used, provide airfoil-turning vanes. Where acoustical lining is indicated, provide turning vanes of perforated metal with glass fiber insulation.

D. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible. Divergence upstream of equipment shall not exceed 30 degrees; convergence downstream shall not exceed 45 degrees.

E. Use crimp joints with bead for joining round duct sizes 6 inch smaller with crimp in direction of airflow.

F. Use double nuts and lock washers on threaded rod supports.

2.4 MEDIUM PRESSURE DUCTS

A. Fabricate and support in accordance with SMACNA (DCS) Standards and ASHRAE handbooks, except as indicated. Provide duct material, gauges, reinforcing, and sealing for operating pressures indicated.

B. Construct T's, bends, and elbows with radius of not less than 1½ times width of duct on centerline. Where not possible and where rectangular elbows are used, provide airfoil-turning vanes. Where acoustical lining is required, provide turning vanes of perforated metal with glass fiber insulation. Weld in place.

C. Transform duct sizes gradually, not exceeding 15 degrees divergence and 30 degrees convergence.

D. Fabricate continuously welded medium and high pressure round and oval duct fittings two gauges heavier than duct gauges indicated in SMACNA Standard. Joints shall be minimum 4 inch cemented slip joint, brazed or electric welded. Prime coat welded joints.

E. Provide standard 45 degree lateral wye takeoffs unless otherwise indicated where 90 degree conical tee connections may be used.

2.5 EXPOSED DUCTWORK LOCATED INDOORS

A. Where ductwork is indicated to be exposed to view in occupied spaces, provide round or flat oval, double wall galvanized steel construction with spiral lockseam with perforated inner liner, United McGill Corporation model Acousti-k27 or approved equal.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

A. Obtain manufacturer's inspection and acceptance of fabrication and installation of ductwork at beginning of installation.

B. Provide openings in ductwork where required to accommodate thermometers and controllers. Provide pitot tube openings where required for testing of systems, complete with metal can with

spring device or screw to ensure against air leakage. Where openings are provided in insulated ductwork, install insulation material inside a metal ring.

C. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.

D. Connect terminal units to medium or high pressure ducts with 18 inches maximum length of flexible duct. Do not use flexible duct to change direction.

E. Connect diffusers or troffer boots to low pressure ducts with 5 feet maximum, 4 feet minimum, length of flexible duct. Hold in place with strap or clamp.

F. During construction, provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.

G. The interior surface of all ductwork shall be smooth. No sheet metal parts, tabs, angles, or anything else may project into the ducts for any reason, except as specified to be so. All seams and joints shall be external.

H. All ductwork located exposed on roof shall be "crowned" to prevent water from ponding. Ref: Insulation for additional requirements.

I. Where ducts pass through non-rated floors, provide structural angles for duct support. Where ducts pass through non-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches. Where ducts pass through rated interior partitions, rated exterior walls, or rated floors, install fire dampers or smoke dampers as required. Provide sleeves for dampers not provided with factory sleeve. Refer to Section 233300 - Ductwork Accessories for fire and smoke damper requirements.

J. All angles shall be carried around all four sides of the duct or group of ducts. Angles shall overlap corners and be welded or riveted.

K. All ductwork shall be fabricated in a manner to prevent the seams or joints being cut for the installation of grilles, registers, or ceiling outlets.

L. All duct hangers shall be attached to building structure. Cutting slots in roof or floor decking for hanger straps to be cast in concrete is not acceptable.

3.2 INSTALLATION OF FLEXIBLE DUCTS

A. Maximum Length: For any duct run using flexible ductwork, do not exceed 5'-0" extended length.

B. Installation: Install in accordance with Section III of SMACNA (DCS).

3.3 DUCTWORK APPLICATION SCHEDULE

A. Ductwork materials shall be provided to comply with the following:

AIR SYSTEM	MATERIAL
Low Pressure Supply	Galvanized Steel, Aluminum
MediumPressure Supply	Galvanized Steel
Return and Relief	Galvanized Steel, Aluminum
General Exhaust	Galvanized Steel, Aluminum
Outside Air Intake	Galvanized Steel
Combustion Air	Galvanized Steel

3.4 DUCTWORK HANGERS AND SUPPORTS

A. All ductwork shall be properly suspended or supported from the building structure. Hangers shall be galvanized steel straps or hot-dipped galvanized rod with threads pointed after installation. Strap hanger shall be attached to the bottom of the ductwork, provide a minimum of two screws one at the bottom and one in the side of each strap on metal ductwork. The spacing, size and installation of hangers shall be in accordance with the recommendations of the latest SMACNA edition.

B. Wire shall not be used for permanent support or attachment components.

C. All duct risers shall be supported by angles or channels secured to the sides of the ducts at each floor with sheet metal screws or rivets. The floor supports may also be secured to ducts by rods, angles or flat bar to the duct joint or reinforcing. Structural steel supports for duct risers shall be provided under this Division.

3.5 AIR DUCT LEAKAGE: (FROM SMACNA DUCT STANDARDS LATEST EDITION) TEST ALL DUCTWORK (DESIGNED TO HANDLE OVER 1,000 CFM) AS FOLLOWS:

A. Test apparatus

1. A source of high pressure air-a portable rotary blower or a tank type vacuum cleaner.
2. A flow measuring device consisting of straightening vanes and an orifice plate mounted in a straight tube with properly located pressure taps. Each orifice assembly shall be accurately calibrated with its own calibration curve. Pressure and flow readings shall be taken with U-tube manometers.

B. Test Procedures

1. Test for audible leaks as follows:
2. Close off and seal all openings in the duct section to be tested. Connect the test apparatus to the duct by means of a section of flexible duct.

    a. Start the blower with its control damper closed.
    b. Gradually open the inlet damper until the duct pressure reaches 1.5 times the standard designed duct operating pressure.

c. Survey all joints for audible leaks. Mark each leak and repair after shutting down blower. Do not apply a retest until sealants have set.

3. After all audible leaks have been sealed, the remaining leakage should be measured with the orifice section of the test apparatus as follows:

a. Start blower and open damper until pressure in duct reaches 50% in excess of designed duct operating pressure.
b. Read the pressure differential across the orifice on manometer No. 2. If there is no leakage, the pressure differential will be zero.
c. Total allowable leakage shall not exceed one (1) percent of the total system design air flow rate. When partial sections of the duct system are tested, the summation of the leakage for all sections shall not exceed the total allowable leakage.
d. Even though a system may pass the measured leakage test, a concentration of leakage at one point may result in a noisy leak which must be corrected.

4. Testing Report

a. Contractor shall provide a testing report for each air system to the engineer. The report shall indicate the completion of testing and compliance with testing specification.
b. All duct testing reports shall be included in the final close out documents.

3.6 DUCT SYSTEM PROTECTION

A. Provide temporary closures at the ends of ducts which are not connected to equipment or air distribution devices at time of ductwork installation; provide temporary closure of polyethylene film or other covering which will prevent entrance of dust and debris until time connections are to be completed.

B. Provide temporary construction filters on air handling equipment and/or return air ductwork during construction to protect ductwork and equipment from dust.

C. Any ductwork stored on site with observable dirt or debris inside shall be cleaned by a third party.

D. If the air handling system has been operated without temporary construction filters or if the integrity of the temporary closures has been compromised, the contractor shall have the duct system cleaned per the following section.

3.7 DUCT SYSTEM CLEANING

A. For renovation projects and HVAC retrofit applications wherein existing duct systems are scheduled to be re-used, or where required by the Duct System Protection section above, the contractor shall have the existing duct systems cleaned in accordance with the current published standards of ASHRAE, NADCA ACR and as indicated below.

B. Duct system cleaning method used shall incorporate the use of vacuum collection devices that are operated continuously during cleaning. A vacuum device shall be connected to the downstream end of the section being cleaned through a predetermined opening. The vacuum collection device must be of sufficient power to render all areas being cleaned under negative pressure, such that containment of debris and the protection of the indoor environment is assured.

C. All vacuum devices exhausting air inside the building shall be equipped with HEPA filters (minimum efficiency), including hand-held vacuums and wet-vacuums.

D. All vacuum devices exhausting air outside the facility shall be equipped with Particulate Collection including adequate filtration to contain debris removed from the HVAC system. Such devices shall exhaust in a manner that will not allow contaminants to re-enter the facility. Release of debris outdoors must not violate any outdoor environmental standards, codes or regulations.

E. Fibrous glass thermal or acoustical insulation elements present in any equipment or ductwork shall be thoroughly cleaned with HEPA vacuuming equipment, while the HVAC system is under constant negative pressure, and not permitted to get wet in accordance with applicable NADCA and NAIMA standards and recommendations.

F. Duct cleaning method used shall not damage the integrity of the ductwork, nor damage porous surface materials such as liners inside the ductwork or system components.

G. Replace the fiberglass material if there is any evidence of damage, deterioration, delamination, friable material, mold or fungus growth, or moisture such that fibrous glass materials cannot be restored by cleaning or resurfacing with an acceptable insulation repair coating.

H. Clean external surfaces of foreign substances which might cause corrosive deterioration of metal or, where ductwork is to be painted, might interfere with painting or cause paint deterioration.

I. Strip protective paper from stainless ductwork surfaces, and repair finish wherever it has been damaged.

J. Cleaning Report: Contractor shall provide a report to the Owner indicating the completion of duct cleaning per specification and areas of the duct system found to be damaged and/or in need of repair.

3.8 DUCT JOINTS AND SEAMS

A. All ductwork shall be constructed to Seal Class A, as referenced in SMACNA (DCS).

B. All non-welded joints and seams shall be sealed. This includes but is not limited to:

1. Transverse joints.
2. Longitudinal seams.
3. Duct wall penetrations.
4. Spin-ins, taps, and other branch connections.

5. Access doors, access panels, and duct connections to equipment.

C. Openings for rotating shafts shall be sealed with bushings.

END OF SECTION 233113

SECTION 233114 - FABRIC AIR DISPERSION SYSTEM

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

B. Section 230200 - Basic Materials and Methods for HVAC shall be included as a part of this Section as though written in full in this document.

1.2 WORK INCLUDED

A. Non-metal fabric ductwork.

B. Internal fabric duct rigid framework and support grids.

C. External hangers, supports, suspension system and related accessories.

D. Air distribution and delivery devices.

1.3 RELATED WORK

A. Section 233113 - Metal Ductwork

B. Section 233300 - Ductwork Accessories

C. Section 230529 - Hangers and Supports for Piping and Equipment - HVAC

D. Section 230593 - Testing, Adjusting, And Balancing

1.4 REFERENCES

A. ASTM D3776/D3776M - Standard Test Methods for Mass Per Unit Area (Weight) of Fabric; 2020.

B. ASTM D737 - Standard Test Method for Air Permeability of Textile Fabrics; 2018.

C. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2024.

D. UL 2518 - Standard for Safety Air Dispersion Systems; Current Edition, Including All Revisions.

E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials

1.5 SUBMITTALS

A. Product Data: Submit manufacturer's specifications on materials and manufactured products used for work of this section, including fabric duct, duct fittings, connections, supports, air delivery devices and all associated accessories.

B. Building Code Data: Submit UL file number under which product is Classified by Underwriters Laboratories.

C. Provide detailed drawings from the fabric duct manufacturer confirming configuration of Fabric Tensioning System (components, support locations, segment lengths) and Textile Dispersion System (diameter, lengths, airflow, pressure, velocity, and textile permeability).

D. Provide detailed installation instructions for components to be installed.

1.6 WARRANTY

A. Manufacturer must provide a complete product (20) twenty year pro-rated warranty for products supplied for the fabric and suspension of this system as well as a Design and Performance Warranty. Laundering frequency nor any other conditions shall pertain to warranty terms.

1. Years (1) one through (10) ten: 100% coverage.
2. Years (11) eleven through (15) fifteen: 50% coverage.
3. Years (16) sixteen through (20) twenty: 25% coverage.

1.7 DELIVERY, STORAGE AND HANDLING

A. Protect fabric air dispersion systems from damage, water, and moisture during shipping, storage and handling.

B. Where possible, store products inside and protect from weather. Where necessary to store outside, store above grade and enclose with a vented waterproof wrapping.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. DuctSox - Sedona Xm

2.2 NON-METAL FABRIC DUCT SYSTEM

A. Fabric

1. Filament/filament twill polyester that includes 55% recycled content, treated with a machine washable EPA approved anti-microbial agent by the fabric manufacturer, fire

retardant in accordance with UL 2518. Non-linting filament yarn to meet the requirements of ISO Class 3 environment.

2. Base Permeability @ 0.5" WG: 2 CFM / ft² per ASTM D737; shall be verified by the Frazier Permeability Test.
3. Weight: 6.8oz. / yd^2 per ASTM D3776/D3776M.
4. Shrinkage: Max. 0.5% per DIN EN 26 630.
5. Temperature Range: -40°F and +284°F.
6. Fire Retardancy: Shall meet the requirements in NFPA 90A, ICC AC167 and UL 2518.
7. Duct Shape: ROUND (coordinate with plans).
8. Fabric Color: Provide sample swatch of actual material and color with submittal and coordinate with the architect.

B. Textile Systems Fabrication Requirements

1. Provide system in modular lengths optimized for maintenance, connected by zippers with proper radial securing clips (inlets, endcaps and mid-sections) and top access zippers (if required) for vertical cable safety attachment. Zippers shall provide closure completely around the circumference to prevent leakage. Required number of zippers shall be specified by the manufacturer.
2. The system shall be made of permeable fabric. Base permeability of fabric shall be reached based on a combination of weave construction and a thermo fixation process in order to prevent permeability degradation after wash. Fabric permeability based on a calendaring process is not acceptable.
3. Inlet connection to metal duct via fabric draw band with anchor patches as supplied by manufacturer. Anchor patches to be secured to metal duct via zip screw fastener - supplied by contractor.
4. Inlet connection includes zipper for easy removal / maintenance.
5. Lengths to include required intermediate zippers as specified by manufacturer.
6. End cap includes zipper for easy maintenance.
7. Each section of the fabric shall include identification labels documenting order number, section diameter, section length, piece number, code certifications and other pertinent information

C. System Design Parameters

1. Fabric duct system shall be designed from 0.25” water gage minimum to 3” maximum, with 0.5” as the standard.
2. Fabric duct system shall be limited to design temperatures between -40°F and +284°F.
3. Design CFM, diameter, air distribution and delivery devices, static pressure and diffuser length shall be designed or approved by the manufacturer.
4. Do not use fabric diffusers in concealed locations.
5. Use fabric diffusers only for positive pressure air distribution components of the mechanical ventilation system.

D. Air Distribution and Delivery

1. Final air distribution and delivery method shall be integral to the non-metal fabric duct system and furnished as a whole, engineered system.
2. Final air distribution and delivery design shall be based on the specific project design parameters for each installation based on the following criteria:

a. Total supply air flow for the space or specific branch.
b. Supply air branch length.
c. Non-metal fabric duct diameter.
d. Throw requirements.
e. Available main supply Air duct static pressure at the branch connection for the non-metal fabric duct.
f. Temperature of supply air and HVAC application; heating only, cooling only, heating and cooling.

3. All final air distribution and delivery methods and devices utilized for each application shall be selected to deliver the required air flow rates with noise criteria (NC) levels not to exceed 30NC.
4. Linear Vents

a. Air dispersion accomplished by linear vent and permeable fabric. Linear vents must be sized in 1 CFM per linear foot increments (based on 0.5" SP), starting a 1 CFM through 90 CFM per linear foot. Linear vent is to consist of an array of open orifices rather than a mesh style vent to reduce maintenance requirements of mesh style vents. Linear vents should also be designed to minimize dusting on fabric surface.
b. Size of vent opening and location of linear vents to be specified and approved by manufacturer.

5. Orifices - 2" & 3" SG's (Sewn-in Grommet)

a. Air dispersion and extended throws are accomplished by reinforced orifices and permeable fabric. Reinforced orifices are to be installed to keep the integrity of opening and withstand laundry processes.
b. Diameter, capacity, and location of reinforced orifices to be specified and approved by manufacturer.

6. Fixed Nozzles

a. Air dispersion accomplished by using conical aerodynamic nozzles and permeable fabric. Diameter of nozzles height to be minimum ½". Due to exact requirements of throw and maximum level of noise alternative flow models are not acceptable.
b. Color of nozzles must match color of fabric. Unless otherwise specifically mentioned on drawings or otherwise in this specification, supplier's standard table is used for selection of color.
c. Location and number of nozzles ot be specified and approved by manufacturer.

7. Adjustable Nozzles

a. Air dispersion accomplished by adjustable ball nozzles and permeable fabric. Adjustable ball nozzles to have multiaxial rotation to redirect airflow to desired area. Adjustable ball nozzles are able to completely close off airflow without adding caps or plugs. Adjustable ball nozzles should lock into place once set, preventing constant adjustment. Adjustable ball nozzle should have inset design to be a condensation resistant product.

b. Colors of adjustable nozzles are available are white and black. With white material receiving white adjustable nozzles and all other material colors receiving black adjustable nozzles unless otherwise specifically mentioned on drawings or otherwise in the specification.
c. Quantity and location of adjustable ball nozzles to be specified and approved by manufacturer.

E. Fabric Duct Fittings

1. The non-metal fabric duct manufacturer shall provide duct fittings based on the specific project design parameters and layout for each installation.
2. Fabric duct fittings shall be constructed of the same fabric as the non-metal duct system and shall meet the same requirements and specifications.
3. Fabric duct fittings shall have the same internal metal support structure and external suspension components as the non-metal duct system.
4. Fabric duct fittings shall be provided for:

a. Radius elbows in 30°, 40°, 60°, and 90° configurations.
b. Duct transitions in increments of 2” duct diameter changes in configurations of center-aligned, top-aligned, and bottom aligned.
c. Tee and branch fittings in both matching branch-to-main diameters and non-matching branch-to-main diameters in center-aligned, top-aligned and bottom aligned configuration, single and dual-sided branches.

F. Internal Frame and Fabric Tensioning System

1. System shall cylindrically tension the duct fabric along the entire length of fabric duct, including all fittings.
2. Tensioning system shall be metallic and shall include full 360 degree tensioning and intermediate rings with quick connection spacer tubes concealed inside the fabric system.
3. Interior structure to include multiple mechanically adjustable tension devices. To provide proper fabric tensioning, structural and fabric system shall be configured in segments of no more than 45 feet.
4. Fabric components supported solely by metal cylindrical rings.
5. Each cylindrical ring shall require vertical metal to metal vertical cable safety attachment.
6. If within a natatorium, all metal structural components shall be able to withstand chlorinated environment and shall not be susceptible to corrosion. Provide necessary coatings and materials.

G. External Hangers, Supports and Suspension

1. Tension Cable System, One row Cable:

a. Systems shall be installed 1-1/2” above top-dead-center. Textile system attachment to cable shall be made using gliders spaced every 24 inches. Available for systems less than 32” diameter. Cable suspension hardware o include cable, eye bolts, thimbles, cable clamps, and turnbuckle(s) as required.
b. Cable suspension options:

1) Galvanized steel cable

2) Stainless steel cable
3) Impregnated steel cable

c. Support lengths available in 5’ (standard), 10’, 15’, & 30’.

2. Tension Cable System, Two Row Cable:

a. Systems shall be installed 1-1/2” above the 10 and 2 o’clock locations. Textiles system attachment to cable shall be made using Gliders spaced every 24 inches. Required for systems of 32”-59” diameter. Available for systems less than 32” diameter. Cable suspension hardware to include cable, eye bolts, thimbles, cable clamps, and turnbuckle(s) as required.
b. Cable suspension options:

1) Galvanized steel cable
2) Stainless steel cable
3) Impregnated steel cable (required for natatorium applications)

c. Support lengths available in 5’ (standard), 10’ 15’, & 30’.

3. Tension Cable System, Three Row Cable:

a. Systems shall be installed 1-1/2" above the 10, 12, and 2 o'clock locations. Textile system attachment to cable shall be made using Gliders spaced every 24 inches. Required for systems of 60" diameter and larger. Available for systems less than 60" diameter. Cable suspension hardware to include cable, eye bolts, thimbles, cable clamps, and turnbuckle(s) as required.
b. Cable suspension options:

1) Galvanized steel cable
2) Stainless steel cable
3) Impregnated steel cable (required for natatorium applications)

c. Support lengths available in 5’ (standard), 10’ 15’, & 30’.

4. U-Track System, One Row U-Track:

a. Systems shall be installed 1-1/2" above top-dead-center. Textile system attachment to cable shall be made using Gliders spaced every 24 inches. Available for systems less than 32" diameter. U-Track suspension hardware to include 8' sections of aluminum track, aluminum splice connectors, track endcaps and vertical cable support kits - consisting of a length of cable with cable connectors. Radius aluminum must be included for all horizontal/flat radius sections.
b. U-Track suspension options:

1) Galvanized steel cable
2) Stainless steel cable
3) Impregnated steel cable

c. Support lengths available in 5’ (standard), 10’ 15’, & 30’.

5. U-Track System, Two Row U-Track:

    a. Systems shall be installed 1-1/2" above the 10 and 2 o'clock locations. Textile system attachment to cable shall be made using Gliders spaced every 24 inches. Required for systems of 32" - 59" diameter. Available for systems less than 32" diameter. U-Track suspension hardware to include 8' sections of aluminum track, aluminum splice connectors, track endcaps and vertical cable support kits - consisting of a length of cable with cable connectors. Radius aluminum track must be included for all horizontal/flat radius sections.
    b. U-Track suspension options:

        1) Galvanized steel cable
        2) Stainless steel cable
        3) Impregnated steel cable

    c. Support lengths available in 5’ (standard), 10’ 15’, & 30’.

6. U-Track System, Three Row U-Track:

    a. Systems shall be installed 1-1/2" above the 10, 12, and 2 o'clock locations. Textile system attachment to cable shall be made using Gliders spaced every 24 inches. Required for systems of 60" diameter and larger. Available for systems less than 60" diameter. U-Track suspension hardware to include 8' sections of aluminum track, aluminum splice connectors, track endcaps and vertical cable support kits - consisting of a length of cable with cable connectors. Radius aluminum track must be included for all horizontal/flat radius sections.
    b. U-Track suspension options:

        1) Galvanized steel cable
        2) Stainless steel cable
        3) Impregnated steel cable

    c. Support lengths available in 5’ (standard), 10’ 15’, & 30’.

PART 3 - EXECUTION

3.1 INSTALLATION OF FABRIC AIR DISPERSION SYSTEM

A. Install chosen suspension system with minor noise and fabric motion at start-up in accordance with the requirements of the manufacturer. Instructions for installation shall be provided by the manufacturer with product. Suspension Track and cable within a natatorium shall be able to withstand chlorinated environment and shall not be susceptible to corrosion. Provide necessary coatings and materials.

3.2 CLEANING AND PROTECTION

A. Clean air handling unit and ductwork prior to the fabric air dispersion system unit-by-unit as it is installed. Clean external surfaces of foreign substance which may cause corrosive deterioration of facing.

B. Temporary Closure: At ends of ducts which are not connected to equipment or distribution devices at time of ductwork installation, cover with polyethylene film or other covering which will keep the system clean until installation is completed.

C. If fabric dispersion system becomes soiled during installation, it should be removed and cleaned following the manufacturers standard terms of laundry.

END OF SECTION 233114

SECTION 233300 - DUCTWORK ACCESSORIES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Volume control dampers.

B. Shutoff Dampers.

C. Round Duct Taps.

D. Fire dampers.

E. Back draft dampers.

F. Air turning devices.

G. Flexible duct connections.

H. Duct access doors.

I. Duct test holes.

1.2 RELATED WORK

A. Section 230200 - Basic Materials and Methods for HVAC

B. Section 230548 - Vibration and Seismic Controls for HVAC Piping and Equipment

C. Section 233113 - Metal Ductwork

1.3 REFERENCES

A. AMCA 500-D - Laboratory Methods of Testing Dampers for Rating; 2018.

B. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

C. ICC (IECC) - International Energy Conservation Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

D. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2024.

E. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2020.

F. UL 33 - Safety Heat Responsive Links for Fire-Protection Service; Current Edition, Including All Revisions.

G. UL 555 - Standard for Fire Dampers; Current Edition, Including All Revisions.

1.4 SUBMITTALS

A. Submit shop drawings and product data under provisions of Division One.

B. Provide shop drawings for shop fabricated assemblies indicated, including volume control dampers duct access doors duct test holes. Provide product data for hardware used.

C. Submit manufacturer's installation instructions under provisions of Division 1, for fire dampers and combination fire and smoke dampers.

PART 2 - PRODUCTS

2.1 VOLUME CONTROL DAMPERS

A. Fabricate in accordance with SMACNA (DCS), and as indicated.

B. Fabricate splitter dampers of material same gauge as duct to 24 inches size in either direction, and two gauges heavier for sizes over 24 inches.

C. Fabricate splitter dampers of double thickness sheet metal to streamline shape. Secure blade with continuous hinge or rod. Operate with minimum 1/2 inch diameter rod in self-aligning, universal joint, action flanged bushing, with set screw.

D. Fabricate single blade dampers for duct sizes to 9-1/2 x 24 inch.

E. Fabricate multi-blade damper of opposed blade pattern with maximum blade sizes 12 x 72 inch.

1. Assemble center and edge crimped blades in prime coated or galvanized channel frame with suitable hardware.
2. On outside air, return air, and all other dampers required to be low leakage type, provide galvanized blades and frames, seven inches wide maximum, with replaceable vinyl, EPDM, silicone rubber seals on blade edges and stainless steel side seals. Provide blades in a double sheet corrugated type construction for extra strength. Provide hat channel shape frames for strength and blade linkage enclosure to keep linkage out of the air stream. Construction leakage not to exceed 1/2%, based on 2,000 fpm and 4 inch static pressure.

F. Except in round ductwork 12 inches and smaller, provide end bearings. On multiple blade dampers, provide oil-impregnated nylon or sintered bronze bearings.

G. Provide locking, indicating quadrant regulators on single and multi-blade dampers. Where rod lengths exceed 30 inches provide regulator at both ends.

H. On insulated ducts mount quadrant regulators on stand-off mounting brackets, bases, or adapters.

2.2 SHUTOFF DAMPERS

A. Fabricate in accordance with SMACNA (DCS), and as indicated.

B. Provide Class I multi-blade damper of parallel blade pattern for all ductwork systems which penetrate the building thermal envelope in accordance with ICC (IECC) and ASHRAE Std 90.1 I-P.

1. Damper shall be constructed of one-piece 16 ga. roll-formed galvanized steel hat-shaped channel frame. Blades shall be 14 ga. roll-formed galvanized steel, airfoil type. Blade edge seals shall be neoprene gaskets mechanically locked to blade edge. Bearings shall be 304 stainless steel, oil-impregnated and self-lubricating sleeve type, turning in extruded holes in damper frame.

C. Shutoff dampers shall have an air leakage rate not greater than 4 cfm/ft^2 of damper surface area at 1.0 in.w.g. and shall be labeled by an approved agency when tested in accordance with AMCA 500-D for such purpose.

2.3 ROUND DUCT TAPS

A. Taps to trunk duct for round flexible duct shall be spin-in fitting with locking quadrant butterfly damper, model no. FLD-B03 by Flexmaster or approved equal.

2.4 ACCEPTABLE MANUFACTURERS - FIRE DAMPERS

A. Greenheck.

B. Louvers and Dampers Inc.

C. Ruskin.

D. Nailor Industries.

E. Pottorff.

2.5 FIRE DAMPERS

A. Fabricate in accordance with NFPA 90A and UL 555, and as indicated.

B. Provide curtain type dampers of galvanized steel with interlocking blades. Provide stainless steel closure springs and latches for horizontal installations. Configure with blades out of air stream. Provide factory sleeve for each damper.

C. Fabricate multiple blade fire dampers per UL with 16 gauge minimum galvanized steel frame and blades, oil-impregnated bronze or stainless steel sleeve bearings and plated steel axles, 1/8 x 1/2 inch plated steel concealed linkage, stainless steel closure spring, blade stops, and lock.

D. Fusible links, UL 33, shall separate at 165 degrees F. Provide adjustable link straps for combination fire/balancing dampers.

2.6 ACCEPTABLE MANUFACTURERS - BACKDRAFT DAMPERS

A. Greenheck.

B. American Warming and Vent.

C. Louvers and Dampers Inc.

D. Ruskin.

E. Pottorff.

F. Substitutions: Under provisions of Division One.

2.7 BACKDRAFT DAMPERS

A. Gravity back draft dampers, size 18 x 18 inches or smaller, furnished with air moving equipment, may be air moving equipment manufacturers standard construction.

B. Fabricate multi-blade, parallel action gravity balanced back draft dampers of 16 gauge galvanized steel, or extruded aluminum, with blades of maximum 6 inch width, with felt or flexible vinyl sealed edges, linked together in rattle-free manner with 90 degree stop, steel ball bearings, and plated steel pivot pin; adjustment device to permit setting for varying differential static pressure.

C. Gravity backdraft dampers shall have an air leakage not greater than 20 cfm/ft^2 where not less than 24 inches in either dimension and 40 cfm/ft^2 where less than 24 inches in either dimension. The rate of air leakage shall be determined at 1.0 in.w.g. when tested in accordance with AMCA 500-D for such purpose.

2.8 ACCEPTABLE MANUFACTURERS - AIR TURNING DEVICES

A. Young Regulator.

B. Titus.

C. Tuttle and Bailey.

D. Substitutions: Under provisions of Division One.

2.9 AIR TURNING DEVICES

A. On duct sizes less than 12 x 12, multi-blade device with blades aligned in short dimension; steel or aluminum construction; with individually adjustable blades, mounting straps.

B. Multi-blade device with radius blades attached to pivoting frame and bracket, steel or aluminum construction, with worm drive mechanism with 18 inch long removable key operator.

2.10 ACCEPTABLE MANUFACTURERS - FLEXIBLE DUCT CONNECTIONS

A. Metaledge.

B. Ventglass.

C. Substitutions: Under provisions of Division One.

2.11 FLEXIBLE DUCT CONNECTIONS TO AIR MOVING EQUIPMENT

A. Fabricate in accordance with SMACNA (DCS) and as indicated.

B. UL listed fire-retardant neoprene coated woven glass fiber fabric to NFPA 90A, minimum density 20 oz. per sq. yd., approximately 6 inches wide, crimped into metal edging strip.

2.12 ACCEPTABLE MANUFACTURERS - DUCT ACCESS DOORS

A. Greenheck.

B. American Warming and Vent.

C. Ruskin.

D. Titus.

E. Substitutions: Under provisions of Division One.

2.13 DUCT ACCESS DOORS

A. Fabricate in accordance with SMACNA (DCS) and as indicated.

B. Review locations prior to fabrication.

C. Fabricate rigid and close-fitting doors of galvanized steel with sealing gaskets and quick fastening locking devices. For insulated ductwork, install minimum one inch thick insulation with sheet metal cover. Insulation shall be replaceable without field cutting or patching.

D. Access doors smaller than 12 inches square may be secured with sash locks.

E. Provide two hinges and two sash locks for sizes up to 18 inches square, three hinges and two compression latches with outside and inside handles for sizes up to 24 x 48 inches. Provide an additional hinge for larger sizes.

F. Access doors with sheet metal screw fasteners are not acceptable.

2.14 DUCT TEST HOLES

A. Cut or drill temporary test holes in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.

B. Permanent test holes shall be factory fabricated, air tight flanged fittings with screw cap. Provide extended neck fittings to clear insulation.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install accessories in accordance with manufacturer's instructions.

B. Balancing Dampers

1. Provide at points on low pressure supply, return, and exhaust systems where branches are taken from larger ducts and as required for air balancing. Use splitter dampers only where indicated.
2. All regulators mounted on externally insulated ductwork shall have 16 gauge elevated platforms at least 1/8 inch higher than the thickness of the insulation. Damper shaft shall have Ventlock No. 607 bearing mounted on ductwork within elevated platform. If duct is inaccessible the operating handle shall be extended and the regulator installed on the face of the wall or ceiling. Where regulators are exposed in finished parts of the building, they shall be flush type, Ventlock No. 666. All regulators shall be manufactured by Ventlock or approved equal.
3. All dampers in lined ductwork shall have bushing to prevent damper damage to liner.

C. Provide fire dampers at locations indicated, where ducts and outlets pass through fire rated components, and where required by authorities having jurisdiction. Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges.

D. Demonstrate re-setting of fire dampers to authorities having jurisdiction and Owner's representative.

E. Provide gravity backdraft dampers or motorized shutoff dampers in accessible location nearest to exterior wall/roof penetrations and where indicated for all outdoor air intake and exhaust systems to automatically shut when the associated systems or spaces served are not in use.

F. Provide flexible duct connections immediately adjacent to equipment in ducts associated with fans and motorized equipment. Provide at least one inch slack at all flexible duct connections.

G. Provide duct access doors for inspection and cleaning before and after filters, coils, fans, automatic dampers, and elsewhere as indicated. Provide minimum 8 x 8 inch size for hand access, 18 x 18 inch size for shoulder access, and as indicated.

H. Provide duct access doors for inspection and maintenance of all fire dampers, smoke dampers, and combination fire/smoke dampers. Provide minimum 12 x 12 inch size access opening where duct size permits. All duct sizes that cannot accommodate a minimum 12 x 12 inch access opening shall be provided with a removable duct section to permit inspection and maintenance of the damper and its operating parts. Removable duct sections shall match the pressure class of the associated duct system, maintain 100 percent of the duct free area, and utilize gaskets and clamp type draw latches to allow removal and reinstallation without the use of tools.

I. Provide duct test holes where indicated and required for testing and balancing purposes.

END OF SECTION 233300

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SECTION 233400 - HVAC FANS

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

B. Section 230200 - Basic Materials and Methods for HVAC shall be included as a part of this Section as though written in full in this document.

1.2 WORK INCLUDED

A. Centrifugal roof ventilators

B. Roof supply fans

1.3 RELATED SECTIONS

A. Section 230200 - Basic Materials and Methods for HVAC

B. Section 230513 - Common Motor Requirements for HVAC Equipment

C. Section 230548 - Vibration and Seismic Controls for HVAC Piping and Equipment

D. Section 230593 - Testing, Adjusting, And Balancing

E. Section 230963 - Energy Management and Control System (EMCS)

F. Section 233300 - Ductwork Accessories

1.4 REFERENCES

A. AMCA 204 - Balance Quality and Vibration Levels for Fans; 2020.

B. AMCA 210 - Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating; 2016, with Errata (2018).

C. AMCA 300 - Reverberation Room Methods of Sound Testing of Fans; 2024.

D. AMCA 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data; 2022.

E. ASCE 7-16 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; 2016.

F. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

G. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014 (Reapproved 2021).

H. FLA (FBC-B) - Florida Building Code: Building (8th Edition); 2023, with Supplement (2024).

I. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

J. ICC (IECC) - International Energy Conservation Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

K. Miami (APD) - Approved Products Directory; Miami-Dade County; Current Edition.

L. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

M. NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations; 2024.

N. UL 705 - Power Ventilators; Current Edition, Including All Revisions.

1.5 QUALITY ASSURANCE

A. UL Compliance: Fans shall be designed, manufactured, and tested in accordance with UL 705.

B. UL Compliance: Fans and components shall be UL listed and labeled.

C. Nationally Recognized Testing Laboratory Compliance (NRTL): Fans and components shall be NRTL listed and labeled. The term "NRTL" shall be as defined in OSHA Regulation 1910.7.

D. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.

E. Electrical Component Standard: Components and installation shall comply with NFPA 70.

F. Sound Power Level Ratings: Comply with AMCA 301. Test fans in accordance with AMCA 300. Fans shall be licensed to bear the AMCA 300 Seal.

G. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings in accordance with AMCA 210.

H. Motors for fans that are not less than 1/12 hp (0.082 kW) and less than 1 hp (0.746 kW) shall be electronically commutated motors per ICC (IECC) and ASHRAE Std 90.1 I-P.

I. High Wind models shall be analyzed and stamped by a state license P.E. to the ASCE 7-16 Standard which meets the ICC (IBC), FLA (FBC-B), and Miami (APD) codes.

J. Each High Wind model is subject to be certified by a Nationally Recognized Testing Laboratory to ASTM E330/E330M.

1.6 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections:

B. Product data for selected models, including specialties, accessories, and the following:

1. Certified fan performance curves with system operating conditions indicated.
2. Certified fan sound power ratings.
3. Motor ratings and electrical characteristics plus motor and fan accessories.
4. Materials, gages and finishes, include color charts.
5. Dampers, including housings, linkages, and operators.
6. Full color paint samples.

C. Shop drawings from manufacturer detailing equipment assemblies and indicating dimensions, weights, required clearances, components, and location and size of field connections.

D. Coordination drawings, in accordance with Division 23, Section "Basic Materials and Methods", for roof penetration requirements and for reflected ceiling plans drawn accurately to scale and coordinating penetrations and units mounted above ceiling. Show the following:

1. Roof framing and support members relative to duct penetrations.
2. Ceiling suspension members.
3. Method of attaching hangers to building structure.
4. Size and location of initial access modules for acoustical tile.
5. Ceiling-mounted items including light fixtures, diffusers, grilles, speakers, sprinkler heads, access panels, and special moldings.

E. Wiring diagrams that detail power, signal, and control wiring. Differentiate between manufacturer installed wiring and field installed wiring.

F. Product certificates, signed by manufacturer, certifying that their products comply with specified requirements.

G. Maintenance data for inclusion in Operating and Maintenance Manual specified in Division 1 and Division 23, Section "Basic Materials and Methods".

H. Provide delegated design submittal for equipment anchorage as required in specification 23 02 00 – Part 1.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Fans shall be stored and handled in accordance with the unit manufacturer’s instructions.

B. Lift and support units with the manufacturer`s designated lifting or supporting points.

C. Disassemble and reassemble units as required for movement into the final location following manufacturer`s written instructions.

D. Deliver fan units as a factory-assembled unit to the extent allowable by shipping limitations, with protective crating and covering.

1.8 ENVIRONMENTAL REQUIREMENTS

A. Do not operate units for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

1.9 OPERATIONS PERSONNEL TRAINING

A. Provide a training session for the owner’s operations personnel. Training session shall be performed by a qualified person who is knowledgeable in the subject system/equipment. Submit a training agenda two (2) weeks prior to the proposed training session for review and approval. Training session shall include at the minimum:

1. Purpose of equipment.
2. Principle of how the equipment works.
3. Important parts and assemblies.
4. How the equipment achieves its purpose and necessary operating conditions.
5. Most likely failure modes, causes and corrections.
6. On site demonstration.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Greenheck Fan Corporation

B. Loren Cook Company

C. Pennbarry

D. ACME

E. Twin City Fan and Blower

2.2 GENERAL DESCRIPTION

A. Provide fans that are factory fabricated and assembled, factory tested, and factory finished with indicated capacities and characteristics.

B. Fans and Shafts shall be statically and dynamically balanced and designed for continuous operation at the maximum rated fan speed and motor horsepower.

C. Provide factory baked-enamel finish coat after assembly. Color for roof mounted fans shall be chosen by Architect during the submittal process.

2.3 CENTRIFUGAL ROOF VENTILATORS

A. Fan shall be a spun aluminum, centrifugal, roof mounted, direct driven or belt driven as indicated.

B. Fan shall be UL 705 listed. Fan shall bear the AMCA certified ratings seal for sound and air performance.

C. The fan shall be of bolted and welded construction utilizing corrosion resistant fasteners. The spun aluminum structural components shall be constructed of minimum 16 gauge marine alloy aluminum, bolted to a rigid aluminum support structure.

D. The aluminum base shall have continuously welded curb cap corners for maximum leak protection. A discharge baffle conduit chase shall be provided through the curb cap and into the motor compartment to facilitate wiring connections.

E. The motor, bearings and drives shall be mounted on a minimum 14 gauge steel power assembly, isolated from the unit structure with rubber vibration isolators. These components shall be enclosed in a weather-tight compartment, separated from the exhaust airstream. Unit shall bear an engraved aluminum nameplate and shall be shipped in transit tested packaging.

F. Wheel shall be centrifugal backward inclined, constructed of 100% aluminum, including a precision machined cast aluminum hub. Wheel inlet shall overlap an aerodynamic aluminum inlet cone to provide maximum performance and efficiency. Wheel shall be balanced in accordance with AMCA 204, balance quality and vibration levels for fans.

G. Motor shall be heavy duty type with permanently lubricated sealed ball bearings.

H. Bearings shall be designed and individually tested specifically for use in air handling applications. Construction shall be heavy duty re-greaseable ball type in a cast iron housing selected for a minimum L50 life in excess of 200,000 hours at maximum cataloged operating speed.

I. Accessories: The following accessories are required.

1. Disconnect Switch: Non-fusible type, with thermal overload protection, mounted inside fan housing, factory-wired through an internal aluminum conduit.
2. Bird Screens: Removable ½ inch mesh, 16 gauge, aluminum or brass wire.
3. Dampers: Gravity backdraft damper or motorized shutoff damper mounted in accessible location. Refer to 233300 - Ductwork Accessories.
4. Roof Curbs: Prefabricated, minimum 12 inch high, heavy-gauge, galvanized steel; mitered and welded corners; 2 inch thick, rigid, fiberglass insulation adhered to inside walls; built-in cant and mounting flange for flat roof decks; and 2 inch wood nailer. Curb heights shall be increased as required to maintain a minimum height of 8 inches above adjacent roofing surface. Size as required to suit roof opening and fan base. Roof curb shall match roof slope so that the curb is level.

2.4 ROOF SUPPLY FANS

A. Roof-mounted, filtered air supply units are of the belt-driven, double width, double inlet (DWDI), forward curved centrifugal blower type. The unit's blower assembly shall be mounted on vibration isolators. Motor drives shall be machine cast iron and variable pitch and shall be factory set to the specified RPM. Belts shall be non-static and oil resistant. Both motor and blower bearings shall be permanently lubricated with sealed ball bearings. The blower housing shall be fabricated of heavy gauge painted steel.

B. Fan shall be UL 705 listed and shall bear the AMCA certified rating seal for sound and air performance.

C. Units housing shall be minimum 18 gauge extruded aluminum with a removable aluminum cover. The insulated cover shall be held in place with bolts for easy access to fan components.

D. Filters shall be permanent, one inch, washable, aluminum type and shall be easily removed for cleaning. Units carry the AMCA Certified Ratings Seal for air performance with filters in place.

E. Accessories: The following items are required.

1. Disconnect Switch: Non-fusible type, with thermal overload protection mounted inside fan housing, factory-wired through an internal aluminum conduit.
2. Bird Screens: Removable ½ inch mesh, 16 gauge, aluminum or brass wire.
3. Dampers: Gravity backdraft damper or motorized shutoff damper mounted in accessible location. Refer to 233300 - Ductwork Accessories.
4. Roof Curb: Prefabricated, minimum 12 inch high, heavy gauge, galvanized steel; mitered and welded corners; 2 inch thick, rigid, fiberglass insulation adhered to inside walls; built-in cant and mounting flange for flat roof decks; and 2 inch wood nailer. Curb heights shall be increased as required to maintain a minimum height of 8 inches above adjacent roofing surface. Size as required to suit roof opening and fan base.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Refer to specification 23 02 00 – Part 1 for anchorage requirements for roof mounted equipment.

C. All items required for a complete and proper installation are not necessarily indicated on the plans or in the specifications. Provide all items required as per manufacturer's requirements.

D. Refer to 230548 - Vibration and Seismic Controls for HVAC Piping and Equipment for additional installation requirements.

E. Flexible duct connections and shutoff dampers are prohibited from being installed in duct systems conveying grease laden exhaust air per NFPA 96 requirements.

END OF SECTION 233400

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SECTION 233713 - AIR DISTRIBUTION DEVICES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Ceiling air diffusers.

B. Wall registers and grilles.

C. Other air devices indicated on drawings and schedules.

1.2 RELATED SECTIONS

A. Section 089100 - Louvers

B. Section 230200 - Basic Materials and Methods for HVAC

C. Section 230593 - Testing, Adjusting, And Balancing

D. Section 230713 - Duct Insulation

E. Section 233113 - Metal Ductwork

F. Section 233300 - Ductwork Accessories

1.3 REFERENCES

A. AHRI 880 (I-P) - Performance Rating of Air Terminals; 2017 (Reaffirmed 2023).

B. AMCA 500-L - Laboratory Methods of Testing Louvers for Rating; 2023.

C. AMCA 540 - Test Method for Louvers Impacted by Wind Borne Debris; 2013.

D. AMCA 550 - Test Method for High Velocity Wind Driven Rain Resistant Louvers; 2022.

E. ASHRAE Std 70 - Method of Testing the Performance of Air Outlets and Air Inlets; 2023.

F. ASTM B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus; 2019.

G. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.

H. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.

I. ASTM D2794 - Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact); 1993 (Reapproved 2024).

J. ASTM D870 - Standard Practice for Testing Water Resistance of Coatings Using Water Immersion; 2015.

K. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

L. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2024.

1.4 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of air distribution devices of types and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Codes and Standards:

1. AHRI Compliance: Test and rate air distribution devices in accordance with AHRI 880 (I-P).
2. ASHRAE Compliance: Test and rate air distribution devices in accordance with ASHRAE Std 70.
3. AMCA Compliance: Test and rate louvers in accordance with AMCA 500-L.
4. AMCA 540 - Test Methods for Louvers Impacted by Wind Borne Debris with Enhanced Protection Approval.
5. AMCA 550 - Test Method for High Velocity Wind Driven Rain Resistant Louvers.
6. AMCA Seal: Provide louvers bearing AMCA Certified Rating Seal.
7. NFPA Compliance: Install air distribution devices in accordance with NFPA 90A - Standard for the Installation of Air Conditioning and Ventilating Systems.
8. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
9. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
10. IBC - International Building Code.
11. IMC - International Mechanical Code.
12. UMC - Uniform Mechanical Code.

1.5 DEFINITIONS

A. Hurricane-prone regions:

1. The U.S. Atlantic Ocean and Gulf of Mexico coasts where the ultimate design wind speed for Risk Category II Buildings is greater than 115 mph;
2. Hawaii, Puerto Rico, Guam, Virgin Islands and American Samoa.

B. Wind-borne debris region: Areas within hurricane-prone regions located:

1. Within 1 mile of the coastal mean high water line where the ultimate design wind speed is 130 mph or greater; or
2. In areas where the ultimate design wind speed is 140 mph or greater. For Risk Category II buildings and structures and Risk Category III building and structures, except health care facilities, the wind-borne debris region shall be based on Figure 1609.3(1). For Risk Category IV buildings and structures and Risk Category III health care facilities, the wind-borne debris region shall be based on Figure 1609.3(2).

C. Ultimate design wind speed - The ultimate design wind speed for the determination of the wind loads shall be determined by Figures 1609.3(1), 1609.3(2) and 1609.3(3) of ICC (IBC).

1.6 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data for the following:

1. Air Distribution Devices

a. Schedule of air distribution devices indicating drawing designation, room location, number furnished, model number, size, and accessories furnished.
b. Data sheet for each type of air distribution devices, and accessory furnished; indicating construction, finish, and mounting details.
c. Performance data for each type of air distribution devices furnished, including aspiration ability, temperature and velocity traverses; throw and drop; and noise criteria ratings. Indicate selections on data.

B. Shop Drawings: Submit manufacturer's assembly-type shop drawing for each type of air distribution device and louver, indicating materials, construction, dimensions, accessories, and installation details.

C. Maintenance Data: Submit maintenance data, including cleaning instructions for finishes, and spare parts lists. Include this data, product data, and shop drawings in maintenance manuals; in accordance with requirements of Division 1.

1.7 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver air distribution devices wrapped in factory-fabricated fiber-board type containers. Identify on outside of container type of outlet or inlet and location to be installed. Avoid crushing or bending and prevent dirt and debris from entering and settling in devices.

B. Store air distribution devices and louvers in original cartons and protect from weather and construction work traffic in accordance with manufacturer’s instructions. Where possible, store indoors; when necessary to store outdoors, store above grade and enclose with waterproof wrapping.

C. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.8 WARRANTY

A. Warrant the installation of the work specified herein for one year against becoming unserviceable or causing an objectionable appearance resulting from defective or nonconforming workmanship.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS - AIR DEVICES

A. Titus Company

B. Krueger

C. Price

2.2 AIR DEVICES

A. Unless otherwise indicated, provide manufacturer's standard air devices when shown of size, shape, capacity, type and accessories indicated on drawings and schedules, constructed of materials and components as indicated and as required for complete installation and proper air distribution.

B. Provide air devices that have, as minimum, temperature and velocity traverses, throw and drop, and noise criteria ratings for each size device and listed in manufacturer's current data.

C. Unless noted otherwise on drawings, the finish shall be #26 white. The finish shall be an anodic acrylic paint, baked at 315°F for 30 minutes. The pencil hardness must be HB to H. The paint must pass a 100-hour ASTM B117 Corrosive Environments Salt Spray Test without creepage, blistering, or deterioration of film. The paint must pass a 250-hour ASTM D870 Immersion Test. The paint must also pass the ASTM D2794 Reverse Impact Cracking Test with a 50 inch-pound force applied.

D. Provide air device with border styles that are compatible with adjacent ceiling or wall system, and that are specially manufactured to fit into the wall construction or ceiling module with accurate fit and adequate support. Refer to architectural construction drawings and specifications for types of wall construction and ceiling systems.

E. Provide integral volume damper with roll formed steel blades where indicated on drawings or schedules. Dampers shall be opposed blade design with a screwdriver slot or a concealed lever operator for adjustment through the face of the air device.

F. Air devices designated for fire rated systems shall be pre-assembled with UL classified radiation damper and thermal blanket. Fire rated air devices shall be shipped completely assembled, one assembly per carton; each assembly shall be enclosed in plastic shrink wrap with installation instructions.

PART 3 - EXECUTION

3.1 INSTALLATION

A. All interior surfaces of all air devices shall be painted flat black.

B. See floor plans for type, neck size and CFM of air for all air distribution devices.

C. Install all air distribution devices as detailed on plans and in accordance with manufacturer's recommendations.

D. The backside of all air devices shall be insulated with taped and sealed external duct wrap to match the insulation thickness and R-value of the ductwork connecting to the air device. Refer to 230713 - Duct Insulation.

E. If opening preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

F. Touch-up, repair or replace any damaged products prior to substantial completion.

END OF SECTION 233713

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SECTION 233723 - HVAC GRAVITY VENTILATORS

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

B. Section 230200 - Basic Materials and Methods for HVAC shall be included as a part of this Section as though written in full in this document.

1.2 WORK INCLUDED

A. Hooded gravity ventilators.

1.3 RELATED SECTIONS

A. Section 230200 - Basic Materials and Methods for HVAC

B. Section 230593 - Testing, Adjusting, And Balancing

C. Section 233300 - Ductwork Accessories

1.4 REFERENCES

A. ASCE 7-10 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; 2010.

B. ASCE 7-16 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; 2016.

C. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

D. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014 (Reapproved 2021).

E. FLA (FBC-B) - Florida Building Code: Building (8th Edition); 2023, with Supplement (2024).

F. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

G. ICC (IECC) - International Energy Conservation Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

H. ISO 9001 - Quality Management Systems — Requirements; 2015, with Amendment (2024).

I. Miami (APD) - Approved Products Directory; Miami-Dade County; Current Edition.

J. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2024.

1.5 QUALITY ASSURANCE

A. Approved ISO 9001 compliant manufacturer listed in this section with minimum 10 years' experience in manufacture of similar products in successful use in similar applications.

B. Nationally Recognized Testing Laboratory Compliance (NRTL): Components shall be NRTL listed and labeled. The term "NRTL" shall be as defined in OSHA Regulation 1910.7.

C. High Wind models shall be analyzed and stamped by a state license P.E. to the ASCE 7-16 Standard which meets the ICC (IBC), FLA (FBC-B) and Miami (APD) codes.

D. Each High Wind model is subject to be certified by a Nationally Recognized Testing Laboratory to ASTM E330/E330M.

E. Shutoff dampers shall be provided as required by ASHRAE Std 90.1 I-P and ICC (IECC).

1.6 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections:

B. Product data for selected models, including specialties, accessories, and the following:

1. Dimensional drawings and product data on each ventilator.
2. Materials, gages and finishes, include color charts.
3. Dampers, including housings, linkages, and operators.
4. Full color paint samples.

C. Shop drawings from manufacturer detailing equipment assemblies and indicating dimensions, weights, required clearances, components, and location and size of field connections.

D. Coordination drawings, in accordance with Division 23, Section "Basic Materials and Methods", for roof penetration requirements and for reflected ceiling plans drawn accurately to scale and coordinating penetrations and units mounted above ceiling. Show the following:

1. Roof framing and support members relative to duct penetrations.
2. Ceiling suspension members.
3. Method of attaching hangers to building structure.
4. Size and location of initial access modules for acoustical tile.

5. Ceiling-mounted items including light fixtures, diffusers, grilles, speakers, sprinkler heads, access panels, and special moldings.

E. Wiring diagrams that detail power, signal, and control wiring. Differentiate between manufacturer installed wiring and field installed wiring.

F. Product certificates, signed by manufacturer, certifying that their products comply with specified requirements.

G. Maintenance data for inclusion in Operating and Maintenance Manual specified in Division 1 and Division 23, Section "Basic Materials and Methods".

H. Provide delegated design submittal for equipment anchorage as required in specification 23 02 00 – Part 1.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Fans shall be stored and handled in accordance with the unit manufacturer’s instructions.

B. Lift and support units with the manufacturer`s designated lifting or supporting points.

C. Disassemble and reassemble units as required for movement into the final location following manufacturer`s written instructions.

D. Deliver fan units as a factory-assembled unit to the extent allowable by shipping limitations, with protective crating and covering.

1.8 OPERATIONS PERSONNEL TRAINING

A. Provide a training session for the owner’s operations personnel. Training session shall be performed by a qualified person who is knowledgeable in the subject system/equipment. Submit a training agenda two (2) weeks prior to the proposed training session for review and approval. Training session shall include at the minimum:

1. Purpose of equipment.
2. Principle of how the equipment works.
3. Important parts and assemblies.
4. How the equipment achieves its purpose and necessary operating conditions.
5. Most likely failure modes, causes and corrections.
6. On site demonstration.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Greenheck Fan Corporation

B. Loren Cook Company

C. Pennbarry

D. ACME

E. Twin City Fan and Blower

2.2 HOODED GRAVITY VENTILATORS

A. Hooded gravity ventilators shall be aluminum construction unless noted otherwise.

B. Hood shall be constructed of precision formed, arched panels with interlocking seams.

C. Vertical end panels shall be fully locked into hood end panels.

D. The aluminum base shall have continuously welded curb cap corners for maximum leak protection.

E. Internal reinforcement and bracing shall be provided as required.

F. Accessories: The following accessories are required.

1. Bird Screens: Removable ½ inch mesh, 16 gauge, aluminum wire.
2. Dampers: Gravity backdraft damper or motorized shutoff damper mounted in accessible location. Refer to 233300 - Ductwork Accessories.
3. Roof Curbs: Prefabricated, minimum 12 inch high, heavy-gauge, galvanized steel; mitered and welded corners; 2 inch thick, rigid, fiberglass insulation adhered to inside walls; built-in cant and mounting flange for flat roof decks; and 2 inch wood nailer. Curb height shall be increased as required to maintain a minimum height of 8 inches above adjacent roofing surface. Size as required to suit roof opening and ventilator base. Roof curb shall match roof slope so that the curb is level.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer’s instructions.

B. Refer to specification 23 02 00 – Part 1 for anchorage requirements for roof mounted equipment.

C. All items required for a complete and proper installation are not necessarily indicated on the plans or in the specifications. Provide all items required as per manufacturer’s requirements.

D. Ensure roof openings are square, accurately aligned, correctly located, and in tolerance prior to installation.

E. Install the roof curb as required by the job conditions and as recommended by the manufacturer and install proper flashing and counterflashing. See details on the Drawings.

F. Set ventilators in place, taking care to protect the adjacent roofing, and make all ductwork connections.

G. Ventilator installation shall comply with NFPA 90A requirements.

END OF SECTION 233723

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SECTION 234100 - AIR FILTERS

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

B. Section 230200 - Basic Materials and Methods for HVAC are included as a part of this Section as though written in full in this document.

1.2 SCOPE

A. Scope of the Work shall include the furnishing and complete installation of the equipment covered by this Section, with all auxiliaries, ready for owner's use.

1.3 REFERENCES

A. ASHRAE Std 52.2 - Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size; 2017, with Addendum (2022).

B. ASHRAE Std 62.1 - Ventilation for Acceptable Indoor Air Quality; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

PART 2 - PRODUCTS

2.1 FILTERS

A. Air filters shall be high efficiency ASHRAE pleated panels consisting of synthetic media, welded wire media support grid, and beverage board enclosing frame, AAF PREpleat M13, 2-inch thick or approved equal.

B. APPROVED MANUFACTURERS

1. American Air Filter.
2. Camfil.
3. Airguard Industries, Inc.
4. Cambridge.
5. Filtration Group

2.2 LOW VELOCITY FILTER SECTION

A. Filters shall be of the throwaway cartridge type in 2-inch frames. When installing multiple filters into slide-in frames tape adjacent filters together with duct tape to prevent bypassing of air around the filter. Media shall be rated at 500 feet per minute.

B. Filtering media shall be formed of non-woven reinforced synthetic type filtering media bonded to 96% open area media support grid folded into a non-creased radial pleat design. The filter pack shall be bonded to the enclosing frame to prevent air bypass. Minimum Efficiency Reporting Value of MERV 13 when evaluated under the guidelines of ASHRAE Std 52.2. Initial resistance shall not exceed 0.30 inches water gauge at 500 fpm face velocity.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Filters shall be provided upstream of all cooling coils or other devices with wetted surfaces through which air is supplied to occupiable spaces per ASHRAE Std 62.1.

B. Install differential pressure switch to activate "Filter Dirty" light when pressure difference across filters reaches 0.5 inches w.g. (adjustable). Locate "filter dirty" lights in mechanical rooms with identifying label.

C. Refer to Section 230200 for additional filter information.

END OF SECTION 234100

SECTION 236426 - ROTARY SCREW WATER CHILLERS

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

B. Section 230200 - Basic Materials and Methods for HVAC shall be included as a part of this Section as though written in full in this document.

1.2 SCOPE

A. Scope of the Work shall include the furnishing and complete installation of the equipment covered by this Section, with all auxiliaries, ready for owner's use.

1.3 REFERENCES

A. AHRI 550/590 (I-P) - Performance Rating of Water-Chilling and Heat Pump Water-Heating Packages Using the Vapor Compression Cycle; 2023.

B. ASHRAE Std 15 - Safety Standard for Refrigeration Systems; 2022, with Addendum (2024).

C. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

D. ASME BPVC-VIII-1 - Boiler and Pressure Vessel Code, Section VIII, Division 1: Rules for Construction of Pressure Vessels; 2023.

E. ICC (IECC) - International Energy Conservation Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

F. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

G. UL 508A - Industrial Control Panels; Current Edition, Including All Revisions.

H. UL 1995 - Heating and Cooling Equipment; Current Edition, Including All Revisions.

1.4 SUBMITTALS

A. Submit shop drawings and product data under provisions of Division One.

B. Submit shop drawings indicating components, assembly, dimensions, weights and loadings, required clearances, and location and size of field connections. Indicate equipment, piping and connections, valves, strainers, and thermostatic valves required for complete system.

C. Verify unit voltage matches voltage on electrical drawings.

D. Submit product data indicating rated capacities, weights, specialties and accessories, electrical requirements and wiring diagrams.

E. Submit written certification that components of package not furnished by manufacturer have been selected in accordance with manufacturer's requirements.

F. Submit manufacturer's installation instructions including: Power, power wiring requirements, control wiring requirements, insulation details for unit motor starter details, etc.

G. Performance Date - Submittal shall include chiller manufacturer's computer generated performance ratings. These computer ratings shall be certified in accordance with AHRI 550/590 (I-P). Computer ratings shall also contain AHRI Certified part load values for operation at 100%, 75%, 50%, and 25% of full load with 2.5 degree F reduction in entering condenser water temperature per every 10% reduction in load. The chiller manufacturer shall guarantee that the chiller will maintain stable operation at the resulting entering condenser water temperatures for these four (4) load points and at 15% of full load with reduced ECWT as stated above.

H. Supporting documentation certifying internally enhanced condenser tubes if provided may be cleaned by conventional means.

1.5 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data under provisions of Division One.

B. Include start-up instructions, maintenance data, parts lists, controls, and accessories. Include trouble-shooting guide.

C. Include instructions on where and how to contact local service and parts centers.

D. Include description and setpoints of controls.

1.6 QUALITY ASSURANCE

A. Unit construction shall comply with UL 1995, NFPA 70 and ASME applicable codes (U.S.A. codes).

B. Conform to AHRI 550/590 (I-P) code for testing and rating of rotary screw chillers.

C. Conform to ASME BPVC-VIII-1 Boiler and Pressure Vessel Code for construction and testing of chillers.

D. Conform to ASHRAE Std 15 code for construction and operation of chillers.

1.7 DELIVERY, STORAGE AND HANDLING

A. Deliver products to site under provisions of Division One.

B. Store and protect products under provisions of Division One.

C. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.

D. Protect units from physical damage. Leave factory shipping covers in place until installation.

1.8 WARRANTY

A. Provide parts and labor warranty for complete chiller package by the equipment manufacturer for one year from start-up or 18 months from date received on site.

B. Provide five year compressor and motor parts and labor warranty by the equipment manufacturer.

1.9 MAINTENANCE SERVICE

A. Furnish service and maintenance of chillers for period of one year from Date of Substantial Completion.

1.10 OPERATIONS PERSONNEL TRAINING

A. Provide a training session for the owner’s operations personnel. Training session shall be performed by a qualified person who is knowledgeable in the subject system/equipment. Submit a training agenda two (2) weeks prior to the proposed training session for review and approval. Training session shall include at the minimum:

1. Purpose of equipment.
2. Principle of how the equipment works.
3. Important parts and assemblies.
4. How the equipment achieves its purpose and necessary operating conditions.
5. Most likely failure modes, causes and corrections.
6. On site demonstration.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Rotary Screw Water Chillers shall not be included in the base bid proposal and shall be listed as an alternate. Provide pricing for each manufacturer listed below.

1. Alternate 3A - Daikin
2. Alternate 3B: Trane
3. Alternate 3C: Carrier

2.2 MANUFACTURED UNITS

A. Provide factory assembled and tested, packaged, water cooled, liquid chillers consisting of rotary screw compressors, compressor motor, condensers, evaporator, refrigerant charge of R-513A, refrigeration accessories, instrument and control panel including gauges and indicating lights, auxiliary components and accessories, and motor starters. Construction and ratings shall be in accordance with AHRI 550/590 (I-P).

B. Units shall have Energy Efficiency Rating (EER) not less than prescribed by ICC (IECC) and ASHRAE Std 90.1 I-P.

2.3 COMPRESSORS

A. Open Drive Units

1. Motor shall be two-pole, continuous duty, squirrel cage, induction type motor, and shall have an open drip proof enclosure (totally enclosed fan cooled motor if exposed to moisture). Motor full load amps shall not exceed either the motor nameplate amps or the amps corresponding to KW specified on the schedule.
2. Motor design shall be such to allow standard connection to the type starter specified. Motor shall be factory mounted.
3. A structural steel bracket between the compressor and the motor shall be furnished to maintain factory alignment.
4. The compressor shall be an open drive, rotary screw type. The compressor housing shall be of cast iron, precision machined to provide minimal clearance for the motors. The rotors shall be manufactured from forged steel and use asymmetric profiles operating at a maximum speed of 3600 RPM.
5. Capacity control shall be achieved to provide fully modulating control from 100% to 15% of full load. Compressors must start unloaded for soft start on motors.
6. The unit shall be capable of operating with lower temperature cooling tower water during part load operation in accordance with AHRI 550/590 (I-P). To maximize part load efficiency the unit must be able to sustain continuous operation with the entering condenser water temperature as low as 15 degree F above the leaving chilled water temperature.

B. Direct Drive Units:

1. Construct semi-hermetic helical rotary screw compressors with rotors of high grade steel or cast iron alloy. Screw compressor shall be of horizontal design and shall have both a male and a female rotor.
2. Statically and dynamically balanced rotating parts.
3. Provide oil lubrication system with oil charging valve and oil filter to ensure adequate lubrication during starting, stopping, and normal operation.
4. Provide compressor with automatic capacity reduction equipment to provide fully modulating control from 100% to 15% of full load.
5. Provide compressor motors for maximum speed of 3600 RPM, suction gas cooled with solid state sensor and electronic winding overheating protection. Compressor motor power factor shall be 0.95 or greater. If the compressor motor power factor is less than 0.95, power factor correction capacitors must be installed.
6. The unit shall be capable of operating with lower temperature cooling tower water during part load operation in accordance with AHRI 550/590 (I-P). To maximize part load efficiency the unit must be able to sustain continuous operation with the entering condenser water temperature as low as 15°F above the leaving chilled water temperature.

2.4 LUBRICATION

A. An adequate supply of oil shall be available to the compressor at all times by pre-lube and post lube oil pump operation. During operation, oil shall be delivered by positive system. An oil reservoir shall be located in the compressor to lubricate bearings in the case of a power failure.

B. An immersion oil heater shall be provided, temperature actuated to effectively remove refrigerant from oil. An external replaceable - cartridge, oil filter shall be provided, along with manual isolation stop valves for ease of servicing. An oil filter differential pressure gauge shall be included to aid in scheduling filter change. An oil eductor shall be provided to automatically remove oil which may have migrated to the evaporator and return it to the compressor. The oil separator shall be of a horizontal design with no moving parts and shall provide effective oil separation before the refrigerant enters the heat exchangers. A refrigerant cooled oil cooler shall be provided to allow operation of chiller over the full range of operating conditions. A water oil cooler may be utilized only if it is a cleanable type.

2.5 EVAPORATOR AND CONDENSER SHELL ASSEMBLIES

A. Evaporator and condenser shall be the shell and tube type designed for 300 psig working pressure on the refrigerant side and be tested at 450 psig. Shells shall be fabricated from rolled carbon steel plate with welded seams; have carbon steel tube sheets, drilled and reamed to accommodate the tubes; and intermediate tube supports spaced no more than four (4) feet apart.

B. The refrigerant side shall be designed, tested and stamped in accordance with ASME BPVC-VIII-1.

C. Tubes shall be individually replaceable.

D. Both shells shall have relief devices to meet the requirements of ASHRAE Std 15.

E. Water boxes shall be removable. Stubout water connection having Victaulic grooves or flanged connections shall be supplied.

F. Water side of shells, include water boxes, shall be designed for 150 psig design working pressure and be tested at 225 psig.

G. Vent and drain connections with plugs shall be provided on each water box.

2.6 REFRIGERANT SYSTEM

A. Refrigerant flow to the evaporator shall be metered by a single fixed orifice with no moving parts.

B. The condenser flow to the evaporator shall be metered by a single fixed orifice with no moving parts.

C. The condenser shell shall be capable of storing the entire system refrigerant charge during servicing. Isolation from the rest of the system shall be by manually operated isolation valves located at the inlet and outlet of the condenser. Additional valves shall be provided to facilitate removal of refrigerant charge from the system.

2.7 UNIT CONTROL PANEL

A. Each unit shall be furnished complete with a micro-computer control center in a locked enclosure, factory mounted, wired, and tested.

B. The control center shall include a touch key pad mounted on the front of the control center which allows the operator to display system operation parameters on a multi-character alphanumeric display that is part of the key pad. These operation parameters include:

1. Chilled water temperatures - leaving and return.
2. Refrigerant pressures - evaporator and condenser.
3. Differential oil pressure at oil filter.
4. Condenser water temperature - leaving and return.
5. Discharge temperature.
6. Three phase volts and three phase amps.
7. Elapsed time meter and number of compressor starts.
8. Oil pressure at compressor.

C. The system setpoints shall be operator entered on the front control center key pad. The setpoints shall be displayed on the multi-character alphanumeric display. The system setpoints shall include:

1. Chilled water temperature (LCHWT).
2. Current Limit

D. Any input that potentially harms the machine shall be rejected and the operator shall be advised via display message.

E. The cause of all system shutdowns (safety or cycling) shall be preserved (until the system is reset or restarted) in the microcomputer's memory for subsequent viewing on the alphanumeric display. The operator shall be continuously advised of system operating conditions by various background and warning messages. The key pad shall contain special service passwords for use by service technicians when performing system troubleshooting.

F. All safety controls shall be annunciated through the alphanumeric display consisting of day, time of shutdown, cause of shutdown, and type of restart required. Safety controls with automatic unit shutdown shall be provided for:

1. Sensor malfunction.
2. Low oil pressure at compressor.
3. High and low refrigerant pressure.
4. Low chilled water temperature.
5. High oil temperature.
6. Starter fault.
7. Unit shall not start without minimum flow through the evaporator or the condenser.

G. Field interlocks shall be provided to differentiate between cycling and safety shutdown. Separate contact closure shall also be furnished to indicate chiller will start (all safeties and cycling devices satisfied) when a remote start signal is received.

H. Chilled water flow detection devices shall be provided to shutdown unit when flow drops below minimum. Devices shall be mounted in a horizontal section of pipe where there is a straight run of at least five pipe diameters on each side of the flow switch.

I. Provide chiller with BACnet interface for integration into an Energy Management and Control System (EMCS) for monitoring of chiller operations. BACnet interface shall be BACnet certified. Chiller interface with EMCS shall include at a minimum:

1. Remote start.
2. Remote stop.
3. Remote LCHWT setpoint (pulse width modulated signal).
4. Remote current limit setpoint (pulse width modulated signal).
5. A "remote mode ready to start" status contact.
6. Safety shutdown status contacts.
7. Cycling shutdown status contacts.
8. Run contacts.

2.8 ELECTRICAL SYSTEM

A. Variable Speed Drive

1. Chiller shall be provided with a variable speed drive (VSD) with circuit breaker, disconnect switch with external lockable handle, and minimum short circuit current rating of 65,000 AIC. The VSD shall be factory mounted on the chiller and shipped completely factory assembled, wired and tested.
2. Drive shall be solid state, microprocessor-based, pulse-width modulation (PWM) type utilizing insulated-gate bipolar transistor (IGBT) output power devices with a power

factor of 0.95 or better at all loads and speeds. VSD full load efficiency shall meet or exceed 97% at 100% VSD rated ampacity.

3. Provide VSD with integral 5% impedance line reactor or DC link reactor to reduce the harmonics to the power line and to add protection from AC line transients. VSD voltage total harmonic distortion (THD) and harmonic current total demand distortion (TDD) shall not exceed 35%.
4. The VSD shall be refrigerant cooled, closed loop water cooled, or air cooled. VSD enclosure cooling shall be microprocessor controlled to maintain temperature within acceptable limits for the VSD enclosure.
5. The VSD controls shall automatically regulate compressor speed and inlet guide vanes to optimize chiller efficiency over all chiller operating conditions while avoiding surge. Movable inlet guide vanes and variable compressor speed shall provide chiller unloading.
6. Surge prevention and surge protection algorithms shall take action to prevent surge and move chiller operation away from surge.
7. The VSDs shall each be furnished in a pre-painted, unit mounted, metal enclosure having a minimum short circuit withstand rating of 65,000 amps per UL 508A. It will include three phase input lugs plus a grounding lug for electrical connections, output motor connection via factory installed bus bars and all components properly segregated and completely enclosed in a single metal enclosure.
8. Chiller manufacturer shall furnish control wiring diagrams for the installation of chiller and associated equipment.
9. Drive shall be suitable for continuous operation at nameplate voltage ±10%. Drive shall be suitable for continuous operation at 100% of nameplate amps and 150% of nameplate amps for 5 seconds.
10. Drive shall be suitable for operation in ambient temperatures between 32 and 104°F, 95% humidity (non-condensing) for altitudes up to 3300 ft above sea level without derating.
11. Drive shall comply with applicable ANSI, NEMA, UL and NEC standards.
12. A single display shall provide interface for programming and display of VSD and chiller parameters. Viewable parameters include:

    a. Operating, configuration and fault messages
    b. Frequency in Hz
    c. Load and line side voltage and current (at the VSD)
    d. kW (line and load side)
    e. IGBT temperatures

13. VSD shall have a control power transformer that provides power to VSD controls and chiller controls. The refrigerant pump fuse, purge unit fuse, purge unit control power, and control power transformer shall be factory wired.
14. The following 115V discrete contact outputs shall be provided for field wiring:

    a. Chilled water pump
    b. Condenser water pump
    c. Alarm status
    d. Tower fan on
    e. Tower fan off

15. The following protections shall be supplied:

    a. Under-voltage

b. Over voltage
c. Over current
d. Phase loss
e. Phase reversal
f. Ground fault
g. Phase unbalance protection
h. Single cycle voltage loss protection
i. Programmable auto re-start after loss of power
j. Motor overload protection (NEMA Class 10)

2.9 PAINTING

A. All external surfaces shall be protected with one coat of durable, alkyd modified vinyl enamel, machinery paint.

2.10 SHIPPING PROTECTION

A. Chiller manufacturer shall provide protective covering on compressor motor, control center, and unit controls. Water nozzles will be capped with fitted sheet metal closures.

2.11 UNIT INSULATION

A. Each unit shall be factory insulated with anti-sweat flexible closed cell plastic type insulation. Insulation shall prevent sweating in environments with dry bulb temperatures in the range of 50-110 degree F. Minimum thickness shall be 3/4" Armaflex AP or equal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide for connection to electrical service.

C. Provide for connection to electrical service. Refer to Division 26. Include for connection of oil pump to separately fused circuit.

D. Provide for connection of electrical wiring between starter and chiller control panel, oil pump, and purge unit. Refer to Division 26.

E. Align chiller on concrete foundations, sole plates, and sub-bases. Level, grout, and bolt in place.

F. Install units on vibration isolation. Refer to Section 230548 - Vibration and Seismic Controls for HVAC Piping and Equipment.

G. Provide evaporator connections to chilled water piping. Refer to Sections 232113 and 232119. On inlet, provide thermometer well for temperature controller, thermometer well and thermometer, strainer, nipple and flow switch, pressure gauge, and shut-off valve. On outlet, provide thermometer well and thermometer, pressure gauge, and balancing valve.

H. Furnish and install necessary auxiliary water piping for oil cooling units and purge condensers.

I. Insulate evaporator and cold surfaces. Refer to Sections 23 07 16 and 230719.

J. Provide condenser connection to condenser water piping. Refer to Sections 232113 and 232119. On inlet, provide thermometer well for temperature limit controller, thermometer well and thermometer, strainer, nipple and flow switch, pressure gage, and shut-off valve. On outlet, provide thermometer well and thermometer, pressure gage, and shut-off balancing valve.

K. Arrange piping for easy dismantling to permit tube cleaning.

L. Provide piping from chiller rupture disc to outdoors. Size as recommended by manufacturer.

3.2 MANUFACTURER'S FIELD SERVICES

A. START-UP: Chiller manufacturer shall furnish start-up service. Refrigerant, oil, evacuation units, and all other miscellaneous materials and tools for start-up shall be furnished by the manufacturer as required. Concurrent owner instruction is to be furnished by the chiller manufacturer. Services shall be documented by a start-up completion record signed off by both the manufacturer and installing contractor.

B. Provide services of factory trained representative for minimum one day to leak test, refrigerant pressure test, start-up, calibrate controls, and instruct Owner on operation and maintenance. Any leaks that are found shall be repaired using methods as recommended by the manufacturer. After repairs have been completed the system shall be evacuated, dehydrated, and fully charged with refrigerant. The chiller shall be re-tested to confirm that the system is leak free.

C. Supply initial charge of refrigerant and oil.

D. Manufacturer shall furnish a start-up completion record, signed by the manufacturer's representative and the installing contractor and shall include:

1. Dates of start-up and personnel in attendance.
2. Dates of owner instruction and personnel in attendance.
3. Design performance data.
4. Actual performance data.

3.3 TRAINING

A. Chiller manufacturer shall, as part of his bid, include the cost of training three owner representatives.

B. This training will be a hands-on and classroom type training which will pertain to the purchased equipment. This training should give the trainees the ability to completely tear down and overhaul the purchased equipment. Any and all literature, manuals or information which is or will be available shall be given to the three trainees.

C. This training will be a two day training session at the owner's facility.

END OF SECTION 236426

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SECTION 237219 - ENERGY RECOVERY VENTILATOR - CORE STYLE

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Indoor/outdoor total enthalpy energy core style air-to-air fixed heat exchanger.

1.2 RELATED SECTIONS

A. Section 230200 - Basic Materials and Methods for HVAC

B. Section 230513 - Common Motor Requirements for HVAC Equipment

C. Section 230526 - Variable Frequency Motor Speed Control for HVAC Equipment

D. Section 230529 - Hangers and Supports for Piping and Equipment - HVAC

E. Section 230548 - Vibration and Seismic Controls for HVAC Piping and Equipment

F. Section 230593 - Testing, Adjusting, And Balancing

G. Section 230963 - Energy Management and Control System (EMCS)

H. Section 233113 - Metal Ductwork

I. Section 233300 - Ductwork Accessories

J. Section 233400 - HVAC Fans

K. Section 234100 - Air Filters

1.3 REFERENCES

A. AHRI 1060 (I-P) - Performance Rating of Air-to-Air Exchangers for Energy Recovery Ventilation Equipment; 2023.

B. AMCA 210 - Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating; 2016, with Errata (2018).

C. ASTM B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus; 2019.

D. ASTM C411 - Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation; 2019.

E. ASTM D610 - Standard Practice for Evaluating Degree of Rusting on Painted Steel Surfaces; 2008 (Reapproved 2019).

F. ASTM D714 - Standard Test Method for Evaluating Degree of Blistering of Paints; 2002 (Reapproved 2017).

G. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2024.

H. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems; 2024.

I. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors; Current Edition, Including All Revisions.

J. UL 1812 - Ducted Heat Recovery Ventilators; Current Edition, Including All Revisions.

1.4 QUALITY ASSURANCE

A. Underwriters Laboratories, Inc. (UL): Provide energy recovery equipment with electrical and control components listed and labeled by UL.

B. National Fire Protection Association (NFPA): Provide energy recovery equipment that is in compliance with requirements of NFPA 90A.

C. Certifications:

1. Performance: Entire unit shall be ETL certified per UL 1812 for core heat exchanger units and shall bare an ETL label. All heat transfer components shall be AHRI 1060 (I-P) certified.
2. Cross Leakage: Provide AHRI 1060 (I-P) certified data on cross Leakage tests.

D. Installation and Start-up: Provide services of a representative authorized by the manufacturer to perform inspection, start-up and certification of each unit.

1.5 SUBMITTALS

A. Provide complete submittal data for each unit including, but not limited to the following:

1. Materials of construction, types and gauges of frame, panels, and supports.
2. Dimensions and weights.
3. Points of all utility connections.
4. Sound data, inlet, outlet and casing radiation.
5. Complete fan performance curves for both supply and exhaust and exhaust air. Air side data including fan types and sizes and air side performance tables or charts.
6. Cross contamination test data.
7. Performance data with psychometric points at all scheduled conditions for both summer and winter.
8. Electrical data including wiring diagrams.

9. Control components and sequences.
10. Combined efficiency data per AHRI guideline V-2003 including RER, COP, unitary net cooling and heating, unitary EER and CEF.

B. For roof mounted units provide delegated design submittal for equipment anchorage as required in specification 23 02 00 – Part 1.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Handling: Handle heat recovery equipment to prevent damage, denting and scoring. Do not install damaged equipment. Replace damage equipment with new.

B. Storage: Store equipment and components in a clean dry place. Protect from the weather, dirt, water and construction debris, and physical damage.

1.7 WARRANTY

A. Provide a warranty by the equipment manufacturer for five years from date of shipment from defects in material and workmanship when used in a proper and normal manner. Manufacturer shall have the option to repair or replace any defective part.

B. Provide a warranty by the equipment manufacturer for the enthalpy core against mechanical defects and performance degradation for a period of ten years from date of manufacturer's start-up. Warrant that the total effectiveness of the enthalpy energy core will be within 5% of the published performance data at the end of ten years when tested in the system. Include in the warranty labor and materials to correct or remedy enthalpy energy core that are found to be defective in performance.

1.8 OPERATIONS PERSONNEL TRAINING

A. Provide a training session for the owner's operations personnel. Training session shall be performed by a qualified person who is knowledgeable in the subject system/equipment. Submit a training agenda two (2) weeks prior to the proposed training session for review and approval. Training session shall include at the minimum:

1. Purpose of equipment.
2. Principle of how the equipment works.
3. Important parts and assemblies.
4. How the equipment achieves its purpose and necessary operating conditions.
5. Most likely failure modes, causes and corrections.
6. On site demonstration.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Trane

B. Venmar Ventilation, Inc.

C. RenewAire

D. Daikin (Core)

2.2 INDOOR/OUTDOOR TOTAL ENTHALPY CORE STYLE AIR-TO-AIR FIXED HEAT EXCHANGER

A. Unit shall be fully assembled at the factory and consist of a double wall insulated metal cabinet, downturn outdoor air intake weatherhood with metal mesh filters, enthalpy core, motorized intake damper, motorized exhaust damper, sensors, curb assembly, frost control, electric preheater, filter assembly for intake and exhaust air, supply air blower assembly, exhaust air blower assembly and an electrical control center. All specified components and internal accessories factory installed and tested and prepared for single-point high voltage connection.

B. Cabinet Materials: Formed double wall insulated metal cabinet, fabricated to permit access to internal components for maintenance.

1. Outside casing: Unit’s exterior shall be supplied from the manufacturer using 18 gauge G60 galvanized steel pre-painted in color as selected by project architect Exterior finish shall be subjected to a salt spray test per ASTM B117 and evaluated using ASTM D714 and ASTM D610 showing no observable signs of rust or blistering until reaching 2,500 hours.
2. Internal Assemblies: 18 gauge, galvanized (G90) steel except for motor supports which shall be minimum 14 gauge galvanized (G90) steel.

C. Access doors shall be hinged with airtight closed cell foam gaskets.

D. Shall have factory-installed duct flanges on all duct openings.

E. Cabinet Insulation: Comply with NFPA 90A and NFPA 90B and erosion requirements of UL 181.

1. Materials: Fiberglass insulation. If insulation other than fiberglass is used, it must also meet the Fire Hazard Classification shown below.

a. Thickness: 1 inch (25 mm)
b. Fire Hazard Classification: Maximum flame spread of 25 and smoke developed of 50, when tested in accordance with ASTM C411.

c. Full coverage of entire cabinet exterior to include walls, roof and floor of unit. Insulation shall be of semi-rigid type and installed between inner and outer shells of all cabinet exterior components.

F. Enthalpy Energy Core: Core shall be of total enthalpy and shall be removable from the cabinet. The core shall consist of a galvanized steel framework (designed to produce laminar air flow through the core). The core media shall be a corrugated hydroscopic resin in a galvanized steel framework and be removable for servicing. Performance criteria are to be as specified in AHRI 1060 (I-P), complying with the Combined Efficiency data in the submittal.

G. Supply Air and Exhaust Air blower assemblies: Blower assemblies consist of an electric motor and a belt driven or direct drive blower. Assembly shall be mounted on heavy gauge galvanized rails and further mounted on 1.125 inch thick neoprene vibration isolators. Refer to equipment schedules for blower drive type.

H. Control panel / connections: Energy Recovery Ventilator shall have an electrical control center where all high and low voltage connections are made. Control center shall be constructed to permit single-point high voltage power supply connections.

I. Frost control: The ERV core shall perform without condensing or frosting under normal operating conditions (defined as outside temperatures above -10ºF and inside relative humidity below 40%). Occasional more extreme conditions shall not affect the usual function, performance or durability of the core. No condensate drains will be allowed.

J. Electric preheater shall be provided for frost control of the energy core. Preheater assembly shall include a thermostat and pressure sensor on the core assembly to initiate frost control sequence. Preheater shall comply with UL 1996 and be constructed on a galvanized steel frame.

K. Motorized dampers / Exhaust Air, Intake Air: Motorized dampers of low leakage type shall be factory installed.

L. Sensors are considered to be part of various optional operational modes or device controllers and are to be factory supplied and installed as specified.

M. Curb Assembly: A curb assembly made of 14 gauge galvanized steel shall be provided by the factory for assembly and installation as part of this division. The curb assembly shall provide perimeter support of the entire unit. Curb assembly shall enclose the underside of the unit and shall be sized to fit into a recess in the bottom of the unit. Contractor shall be responsible for coordinating with roofing contractor to ensure curb unit is properly flashed to provide protection against weather/moisture penetration. Contractor shall provide and install appropriate insulation for the curb assembly. Provide minimum 14 inch high curb. Curb height shall be increased as required to maintain a minimum height of 8 inches above adjacent roof surface.

N. Blower:

1. Blower section construction, Supply Air and Exhaust Air: Belt drive motor and blower units shall be assembled onto a 14 gauge galvanized steel platform and must have neoprene vibration isolation devices. Direct drive motor and blower units shall be assembled with neoprene vibration isolation devices.

2. Blower assemblies: Shall be statically and dynamically balanced and designed for continuous operation at maximum rated fan speed and horsepower.
3. Centrifugal blower housing: Formed and reinforced steel panels to make curved scroll housing with shaped cutoff.
4. Forward curved blower (fan) wheels: Galvanized or aluminum construction with inlet flange and shallow blades curved forward in direction of airflow that are mechanically attached to shaft with set screws.
5. Blower section motor source quality control: Blower performance shall be factory tested for flow rate, pressure, power, air density, rotation speed and efficiency. Ratings are to be established in accordance with AMCA 210.

O. Motors:

1. General: Blower motors greater than 3/4 horsepower shall be "NEMA Premium™" unless otherwise indicated. Minimum compliance with EPAct minimum energy-efficiency standards for single speed ODP and TE enclosures is not acceptable. Motors shall be heavy-duty, permanently lubricated type to match the fan load and furnished at the specified voltage, phase and enclosure. Drives shall be sized for a minimum of 150% of driven horsepower and pulleys shall be fully machined cast-type, keyed and fully secured to the fan wheel and motor shafts. Electric motors of ten horsepower or less shall be supplied with an adjustable drive pulley. Comply with requirements in Division 23 05 13, matched with fan load.
2. Motors shall be 60 cycle, single, or three phase, voltage as called for on mechanical equipment schedule.

P. Unit Controls

1. The unit shall be constructed so that it can function as a stand-alone heating and cooling system controlled by factory-supplied controllers, thermostats and sensors or it can be operated as a heat recover ventilation system controlled by a Building Management System (BMS). This unit shall be controlled by a factory-installed microprocessor programmable controller (DDC) that is connected to various optional sensors.
2. Unit shall incorporate a DDC controller with integral LCD screen that provides text readouts of status, operating settings and alarm conditions. DDC controller shall have a built-in keypad to permit operator to access read-out screens and change settings without the use of ancillary equipment, devices or software. DDC controllers that require the use of equipment or software that is not factory-installed in the unit are not acceptable. Alarm readouts consisting of flashing light codes are not acceptable.

    a. Operating protocol: The DDC shall be factory-programmed for BACnet MSTP for monitoring of the unit's status and control of the unit's functions.

3. Variable Frequency Drive (VFD) Unit shall have factory installed variable frequency for modulation of the blower motors. The VFDs shall be factory-programmed for unit-specific requirements and shall not require additional field programming to operate.
4. Sensors:

    a. Dirty Filter Sensor
    b. Temperature Sensors- OAI, EAW, RAI, OAAW, OAD
    c. Pressure Sensor- OAW-P, OAF-P, EW-P, EF-P

d. Current Sensor- OAF-A, EF-A

Q. Filters

1. Unit shall have permanent washable metal filters located in the outdoor air intake and shall be accessible from the exterior of the unit. MERV 13 disposable pleated filters shall be provided in the intake air stream and MERV 11 filters in the exhaust air stream.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install heat recovery units in accordance with the equipment manufacturer's written instructions.

B. Refer to specification 23 02 00 – Part 1 for anchorage requirements for roof mounted equipment.

C. Locations for equipment shown on the drawings are approximate. Locate units so that they may be adequately serviced and repaired.

D. Block off or cap or otherwise seal openings in the cabinet to prevent entry of dirt and debris until connections are made.

E. Set each unit level and straight.

F. Remove all shipping blocks and restraints.

G. Open access panels and inspects for any abnormalities.

H. Make condensate drain connection. Verify that drain in properly trapped, vented and sloped to floor drain as shown on the drawings.

I. Make duct connections using flexible connectors. Verify that duct is independently and adequately supported.

J. Clean the exterior of each unit to remove dirt, debris, etc.

3.2 AUTHORIZED START-UP, TEST AND ADJUST

A. Provide authorized representative of the manufacturer to inspect the assembly and installation of each unit. Perform no start-up, tests, or adjustments on a unit until the representative determines that the unit has been properly assembled and installed.

B. The representative shall start-up, test, and adjust units. The representatives shall perform operational checks to make certain that all equipment and controls of the systems are operating properly. If defects or improper adjustments are found, they shall be corrected, and the tests shall be repeated.

C. The representative shall prepare and provide a written start-up report to include any measurements taken, test results obtained, or corrective actions required.

3.3 TRAINING

A. Provide training by a factory authorized representative on the operation, repair and maintenance of the system.

B. Submit training and operating manuals, spare parts lists and component drawings bound together in a hard cover binder.

C. Submit three copies of the operation, training, and maintenance manual.

3.4 SERVICES

A. Provide manufacturer’s representative inspection services every six months during the warranty period for the enthalpy cores.

B. Provide services including:

1. Verification of correct alignment of the seals,
2. Inspection and replacement of seals and drive belts, if necessary,
3. Verification of proper operation of controls.
4. Lubrication of bearings.
5. General condition of the whole unit, including cleanliness of enthalpy core, casing, and filters.

C. Services shall not include normal preventative maintenance services normally performed by the Owner, such as filter replacement, fan belt replacement.

D. Representative shall prepare and provide the Owner a brief written report for each site visit. Report shall include conditions that the Owner needs to correct such as dirty filter, damage to the unit from outside sources, loose fan belts, etc.

END OF SECTION 237219

SECTION 237313 - MODULAR INDOOR CENTRAL STATION AIR HANDLING UNITS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Indoor central station air handling unit.

1.2 RELATED SECTIONS

A. Section 230200 - Basic Materials and Methods for HVAC

B. Section 230516 - Expansion Fittings and Loops for HVAC Piping

C. Section 230513 - Common Motor Requirements for HVAC Equipment

D. Section 230526 - Variable Frequency Motor Speed Control for HVAC Equipment

E. Section 230548 - Vibration and Seismic Controls for HVAC Piping and Equipment

F. Section 230713 - Duct Insulation

G. Section 233113 - Metal Ductwork

H. Section 233300 - Ductwork Accessories

I. Section 233400 - HVAC Fans

J. Section 234100 - Air Filters

1.3 REFERENCES

A. AHRI 260 - Sound Rating of Ducted Air Moving and Conditioning Equipment; 2011.

B. AHRI 410 - Forced-Circulation Air-Cooling and Air-Heating Coils; 2001, with Addenda (2011).

C. AHRI 430 (I-P) - Performance Rating of Central Station Air-handling Unit Supply Fans; 2020.

D. AMCA 210 - Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating; 2016, with Errata (2018).

E. AMCA 300 - Reverberation Room Methods of Sound Testing of Fans; 2024.

F. ASHRAE Std 111 - Measurement, Testing, Adjusting, and Balancing of Building HVAC Systems; 2008, with Errata (2019).

G. ASHRAE Std 15 - Safety Standard for Refrigeration Systems; 2022, with Addendum (2024).

H. ASHRAE Std 62.1 - Ventilation for Acceptable Indoor Air Quality; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

I. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

J. ICC (IECC) - International Energy Conservation Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

K. NEMA MG 1 - Motors and Generators; 2021.

L. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

M. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2024.

1.4 QUALITY ASSURANCE

A. Unit performance shall be certified in accordance with AHRI 430 (I-P) for central station air handling units.

B. Coil performance shall be certified in accordance with AHRI 410.

C. Direct-expansion coils shall be designed and tested in accordance with ASHRAE Std 15 Safety Code for Mechanical Refrigeration.

D. Insulation and insulation adhesive shall comply with NFPA 90A requirements or flame spread and smoke generation.

E. Unit shall be rated for sound performance in accordance with AHRI 260 and AMCA 300.

F. Unit shall be provided to comply with the maximum allowable fan horsepower per ICC (IECC) and ASHRAE Std 90.1 I-P.

1.5 GENERAL DESCRIPTION

A. Indoor mounted, central station air handling unit designed to provide air to a conditioned space as required to meet specified performance requirements for ventilation, heating, cooling, filtration, and distribution. Unit shall be assembled for horizontal/vertical application and arranged to discharge conditioned air as shown on the drawings. Units shall be supplied by the specified manufacturer.

1.6 SUBMITTALS

A. Submit shop drawings and product data under provisions of Division One.

B. Shop drawings shall indicate assembly, unit dimensions, weight loading, required clearances, construction details, and field connection details.

C. Product data shall indicate dimensions, weights, capacities, ratings, fan performance, motor electrical characteristics, and gauges and finishes of materials.

D. Provide fan curves with specified operating point clearly plotted.

E. Submit product data of filter media, filter performance data, filter assembly, and filter frames.

F. Submit electrical requirements for power supply wiring including wiring diagrams for interlock and control wiring, clearly indicating factory installed and field installed wiring.

G. Submit manufacturer's installation instructions under provisions of Division One.

H. Submit operation and maintenance data under provisions of Section 230200.

I. Include instructions for lubrication, filter replacement, motor and drive replacement, spare parts lists, and wiring diagrams.

1.7 WARRANTY

A. The air handling unit manufacturer shall warrant parts and labor for a period of eighteen (18) months from date of shipment, or twelve (12) months from date of start-up, whichever occurs first.

1.8 DELIVERY, STORAGE AND HANDLING

A. Unit shall be stored and handled in accordance with the unit manufacturer's instructions.

1.9 ENVIRONMENTAL REQUIREMENTS

A. Do not operate units for any purpose, temporary or permanent, until ductwork is clean, filters are in place, and fan has been test-run under observation.

1.10 OPERATIONS PERSONNEL TRAINING

A. Provide a training session for the owner's operations personnel. Training session shall be performed by a qualified person who is knowledgeable in the subject system/equipment. Submit a training agenda two (2) weeks prior to the proposed training session for review and approval. Training session shall include at the minimum:

1. Purpose of equipment.

2. Principle of how the equipment works.

3. Important parts and assemblies.

4. How the equipment achieves its purpose and necessary operating conditions.

5. Most likely failure modes, causes and corrections.

6. On site demonstration.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Carrier

B. Trane

C. JCI

D. Daikin

E. Custom Air Products

F. Temtrol

2.2 GENERAL DESCRIPTION

A. Unit shall be factory supplied, central station air handler suitable for the capacities and configurations as shown on drawings. Unit may consist of a fan and coil section with a factory installed chilled water or direct-expansion coil, heating coil section, electric heat section, face and bypass section, filter section, access section, mixing box or combination filter-mixing box, return fan, diffuser, or air blender as indicated on the drawings.

B. All sections, whether assembled into a unit or supplied as separate components, shall have mating flanges for bolted assembly. The flange shall extend around the complete perimeter of each section. The manufacturer shall supply bolts and sufficient closed cell gasket for full perimeter coverage.

2.3 CASING

A. All unit sections shall be supplied with a formed galvanized steel perimeter base rail of at least 6 inches in height designed to support the weight and structural integrity of the unit. Condensate drain connection will not penetrate the base rail. If external isolators are not used, provide 6 inch minimum height housekeeping pads or sufficient overall height to provide p-trap with 1 inch greater that unit total static pressure.

B. Unit panels for all sections shall be double wall construction and shall be constructed of minimum 18 gauge G90 mill galvanized steel. Casing panels shall be fully removable for easy access to the unit, and shall be secured to structural frame with aluminized or cadmium plated screws. Removal of panels must not affect the structural integrity of the unit. All panels shall have a minimum of 2-inch thick foam insulation (R-13). All panels shall be completely gasketed prior to shipping.

C. Casing air leakage shall not exceed Leakage Class 6 per ASHRAE Std 111 at +/- 8" w.g. Specified air leakage shall be accomplished without the use of caulk. Total estimated air leakage shall be reported for each unit in CFM, as a percentage of supply air, and as an ASHRAE Std 111 Leakage Class in the submittal. Unit casing (wall/floor/roof panels and doors) shall be able to withstand up to 1.5 times design static pressure, or 8" w.g., whichever is less, and shall not exceed 0.0042" per inch of panel span (L/240). Floor panels shall be double-wall construction and designed to support a 300 lb. load during maintenance activities and shall deflect no more than 0.0042" per inch of panel span.

D. Double wall hinged removable access doors with multiple handles shall be provided in the fan, coil, and filter sections on the drive side of the unit. Access doors must also be provided in all sections where the removal of sheet metal screws is required for unit access. Doors shall be of the same thickness and construction as the wall panels. A gasket shall be provided around the entire door perimeter. Access sections shall be installed where indicated on the drawings and shall be double walled hinged door.

2.4 FANS

A. Units shall be provided with direct-driven, single-width, single-inlet (SWSI) airfoil plenum fans constructed per AMCA requirements for the duty specified. Class I fans are not acceptable. Fan wheels shall be aluminum construction and rated in accordance with and certified by AMCA 210. All fans shall be selected to deliver the specified airflow quantity at the specified operating Total Static Pressure and specified fan/motor speed. The fan shall be selected to operate at a system Total Static Pressure that does not exceed 90% of the specified fan's peak static pressure producing capability at the specified fan/motor speed. Fans shall be selected such that the operating speed at peak design airflow conditions is not greater than 25% above the associated motor synchronous speed. Fans driven by motors operated by variable frequency drive shall not exceed the maximum fan RPM allowed by the manufacturer under a bypass condition. Each fan/motor assembly shall include a minimum 14 gauge spun steel fan inlet funnel, and a G90 galvanized steel motor support plate and fan base with 2" spring type vibration isolation. Provide horizontal spring type thrust restraints between the unit casing and each fan/motor assembly.

B. Units delivering supply airflow rates of significant magnitude shall be equipped with multiple supply fans in an array configuration. Refer to scheduled values to verify motor quantity per unit. Where multiple fans are provided, backdraft dampers shall be mounted upstream of each fan for isolation and a single source power motor control panel shall be factory installed. All fans shall be factory-wired to motor control panel which shall consist of individual motor overload relays and on-off disconnect switch for power isolation.

2.5 MOTORS

A. All motors shall be premium efficiency, totally enclosed fan-cooled (TEFC), selected at the specified operating voltage, RPM, and efficiency as specified or as scheduled elsewhere. Motors shall meet the requirements of NEMA MG 1 Part 30 and 31, section 4.4.2. Motor HP shall not exceed the scheduled HP as indicated in the AHU equipment schedules.

B. All fan motors shall be operated from variable frequency drives. Variable frequency drives shall be furnished, installed, and wired by the installing Contractor. Reference Section 230526 - Variable Frequency Motor Speed Control for HVAC Equipment for additional VFD requirements. A factory inverter drive balance shall be performed on all air handling units to identify resonant frequencies. A report of the results shall be provided for unit startup purposes.

C. All motors operated by variable frequency drive shall be equipped with a maintenance free, conductive microfiber, shaft grounding ring with a minimum of two rows of circumferential microfibers to discharge electrical shaft currents within the motor and/or its bearings.

2.6 COILS

A. All coils shall be tested at 300 psig air pressure, under water.

B. All coils shall be installed on tracks for easy removal from the air handling unit. Units that require disassembly of the unit for coil removal are not acceptable.

C. Coils shall be aluminum plate fin type with belled collars and shall be bonded to 1/2 inch or 5/8 inch OD copper tubes by mechanical expansion. Coils shall have headers with steel MPT connections. Working pressure shall be 250 psig at 300°F.

D. All coil segments shall be furnished with 304 stainless steel coil casings and 304 stainless steel coil supports.

E. Coils shall be drainable and have non-trapping circuits. Headers shall have drain and vent connections extended to the outside of the unit casing. Supply and return headers shall be clearly labeled on the outside of the unit. Provide grommets at all pipe penetrations through cabinet.

F. Main drain pan shall be double wall stainless steel with minimum 2 inch insulation, sloped toward drain fitting, with integral elbow for side discharge and FPT connection, and shall comply with ASHRAE Std 62.1. A maximum of one drain shall be supplied for each cooling coil section which shall extend at least 18” downstream of the coil. The unit design shall not require a drain pan in any downstream section to contain the coil condensate. Moisture shall not carry over past the coil. Moisture eliminators are not acceptable for moisture carryover prevention.

G. Direct expansion coils shall be furnished with a brass distributor with solder type connections. Suction and discharge connections shall be on the same end regardless of row depth. Coils shall have intertwined circuits for equal operation on each circuit. Provide the number of distributors equal to the quantity of refrigerant circuits to the associated condensing unit. Direct expansion coil shall be selected to match the saturated suction temperature and capacity of the associated condensing unit.

H. Maximum face velocity across cooling coils shall be 500 FPM, unless noted otherwise on equipment schedule.

I. Coils in series shall have a minimum of 14 inch access section between coil casings.

J. In units larger than 10,000 cfm, coils shall be removable through a service panel without disassembly of the unit.

2.7 FILTERS

A. Filter section shall accept 2 inch or 4 inch filters of standard sizes as indicated on drawings and shall be designed and constructed to house the type of filter specified. Section shall include side access slide rails.

B. A magnahelic differential pressure gauge shall be factory installed and flush mounted on drive side to measure the pressure drop across the filter.

C. A dirty filter allowance of 0.50” w.g. shall be incorporated into the total static pressure calculation of each air handling unit filter section.

D. Reference Section 234100 - Air Filters for additional requirements.

2.8 MIXING BOXES AND INLET PLENUMS

A. Mixing boxes and inlet plenums shall be factory installed unless otherwise indicated on the Mechanical Drawings.

B. Field fabricated mixing boxes and sheet metal plenums shall be provided by the installing Contractor where indicated on the Mechanical Drawings. When field fabricated mixing boxes are provided, the installing Contractor and EMCS Contractor shall provide outside air and return air motorized control dampers and actuators.

C. Factory installed mixing boxes, economizer, and/or inlet plenums shall have factory mounted motorized control dampers. Dampers shall be opposed blades and interconnecting outside air, return air, and mixed air (if applicable) type. Installing EMCS Contractor shall furnish damper actuators. All factory installed mixing boxes shall have a double wall hinged access door on the drive side of the unit.

2.9 ACCESSORIES

A. All damper blades shall be galvanized steel, double skin airfoil type, housed in a galvanized steel frame and mechanically fastened to a hex axle rod rotating in stainless steel bearings. Dampers shall be sectionalized to limit blade length to no more than 48 inches so as to minimize blade warpage. Blade seals are required to assure tight closure. The damper shall be rated for a maximum leakage rate of 1 percent of nominal airflow at 1 inch w.g.

PART 3 - EXECUTION

3.1 INSTALLATION

A. If floor mounted air handling units are furnished with internal vibration isolation option, provide 2" thick Amber/Booth type NRC ribbed neoprene pads or approved equal to address high frequency breakout and provide additional unit elevation with overall sufficient height to provide p-trap with one inch greater than the unit total static pressure. Ribbed neoprene pads shall be located in accordance with the air handling unit manufacturer's recommendations. Condensate drain connection shall not penetrate the base air handling unit's rail.

B. Install in accordance with manufacturer's instructions.

C. All items required for a complete and proper installation are not necessarily indicated on the plans or in the specifications. Provide all items required as per manufacturer's requirements.

D. Make electrical connections, taking care that these do not block access to any part of the equipment requiring service.

E. Unit wiring shall comply with NFPA 70 and all applicable UL standards.

F. Connect full size condensate drain pipe to air handling unit and extend to nearest drain.

G. Unit installation shall comply with NFPA 90A requirements.

H. System Startup Requirements: The installing Contractor service technician shall startup all air handling units. Technician shall at a minimum perform the following steps for each unit:

1. Energize the unit disconnect switch.

2. Verify correct voltage, phases and cycles.

3. Energize fan motor and verify correct direction of rotation.

4. Re-check damper operation: verify that unit cannot and will not operate with all dampers in the closed position.

5. Energize fan motors and verify that motor FLA is within manufacturer's tolerance of nameplate FLA for each phase.

6. Program unit VFD to skip or lockout resonant frequencies that were identified by the manufacturer's factory inverter drive balance to prevent the VFD from continuously operating at these frequencies.

I. Do not operate units for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings lubricated, and fans have been test run under observation.

J. The installing Contractor shall comply with manufacturer's start-up requirements to ensure safe and correct operation.

END OF SECTION 237313

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SECTION 238126 - SPLIT SYSTEM AIR-CONDITIONERS

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

B. Section 230200 - Basic Materials and Methods for HVAC shall be included as a part of this Section as though written in full in this document.

1.2 WORK INCLUDED

A. Indoor air conditioning units with microprocessor-based controls.

B. Outdoor remote mounted air-cooled condensing units

C. The system shall have a total cooling capacity and a sensible cooling capacity as indicated in the Mechanical Schedules.

D. The unit is to be supplied for operation on a power supply as indicated in the Mechanical Schedules and the Electrical drawings.

1.3 RELATED SECTIONS

A. Section 230200 - Basic Materials and Methods for HVAC

B. Section 230529 - Hangers and Supports for Piping and Equipment - HVAC

C. Section 230513 - Common Motor Requirements for HVAC Equipment

D. Section 230548 - Vibration and Seismic Controls for HVAC Piping and Equipment

E. Section 230719 - HVAC Piping Insulation

F. Section 232300 - Refrigerant Piping

G. Section 234100 - Air Filters

H. Section 230593 - Testing, Adjusting, And Balancing

I. Section 232113 - Above Ground Hydronic Piping

J. Section 232119 - Hydronic Specialties

1.4 REFERENCES

A. AHRI 210/240 - Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment; 2023.

B. AMCA 210 - Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating; 2016, with Errata (2018).

C. AMCA 300 - Reverberation Room Methods of Sound Testing of Fans; 2024.

D. AMCA 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data; 2022.

E. ISO 9001 - Quality Management Systems — Requirements; 2015, with Amendment (2024).

F. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

G. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2024.

H. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems; 2024.

I. UL 1995 - Heating and Cooling Equipment; Current Edition, Including All Revisions.

J. UL 705 - Power Ventilators; Current Edition, Including All Revisions.

1.5 QUALITY ASSURANCE

A. The unit shall be approved and listed by Underwriters' Laboratories, Inc. Unit performance shall be certified in accordance with AHRI 210/240.

B. The specified system shall be factory-tested before shipment. Testing shall include but shall not be limited to: Quality Control Checks, "Hi-Pot" Test (two times rated voltage plus 1000 volts, per NRTL agency requirements), and Metering Calibration Tests. The system shall be designed and manufactured according to world-class quality standards. The manufacturer shall be ISO 9001 certified.

C. System shall be supplied with CSA Certification to the harmonized U.S. and Canadian product safety standard CSA C22.2 No 236/UL 1995 for "Heating and Cooling Equipment" and marked with the CSA c-us logo (60Hz only).

D. UL Compliance: Fans shall be designed, manufactured, and tested in accordance with UL 705.

E. UL Compliance: Fans and components shall be UL listed and labeled.

F. Nationally Recognized Testing Laboratory Compliance (NRTL): Fans and components shall be NRTL listed and labeled. The term "NRTL" shall be as defined in OSHA Regulation 1910.7.

G. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.

H. Electrical Component Standard: Components and installation shall comply with NFPA 70.

I. Sound Power Level Ratings: Comply with AMCA 301. Test fans in accordance with AMCA 300. Fans shall be licensed to bear the AMCA Certified Sound Ratings Seal.

J. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings in accordance with AMCA 210.

1.6 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections:

B. Product data for selected models, including specialties, accessories, and the following:

1. Certified fan performance curves with system operating conditions indicated.
2. Certified fan sound power ratings.
3. Motor ratings and electrical characteristics plus motor and fan accessories.
4. Materials, gages and finishes, include color charts.

C. Shop drawings from manufacturer detailing equipment assemblies and indicating dimensions, weights, required clearances, components, and location and size of field connections.

D. Wiring diagrams that detail power, signal, and control wiring. Differentiate between manufacturer installed wiring and field installed wiring.

E. Product certificates, signed by manufacturer, certifying that their products comply with specified requirements.

F. Maintenance data for inclusion in Operating and Maintenance Manual specified in Division 1 and Division 23, Section "Basic Materials and Methods".

G. For roof mounted outdoor units provide delegated design submittal for equipment anchorage as required in specification 23 02 00 – Part 1.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Equipment shall be stored and handled in accordance with the unit manufacturer’s instructions.

B. Lift and support units with the manufacturer's designated lifting or supporting points.

C. Disassemble and reassemble units as required for movement into the final location following manufacturer's written instructions.

D. Deliver units as a factory-assembled unit to the extent allowable by shipping limitations, with protective crating and covering.

1.8 ENVIRONMENTAL REQUIREMENTS

A. Do not operate units for any purpose, temporary or permanent, until filters are in place, bearings lubricated, refrigeration piping has been tested and charged and fan has been test run under observation.

1.9 OPERATIONS PERSONNEL TRAINING

A. Provide a training session for the owner's operations personnel. Training session shall be performed by a qualified person who is knowledgeable in the subject system/equipment. Submit a training agenda two (2) weeks prior to the proposed training session for review and approval. Training session shall include at the minimum:

1. Purpose of equipment.
2. Principle of how the equipment works.
3. Important parts and assemblies.
4. How the equipment achieves its purpose and necessary operating conditions.
5. Most likely failure modes, causes and corrections.
6. On site demonstration.

1.10 WARRANTY

A. Provide a full parts, labor, and refrigerant warranty by the equipment manufacturer for one year from start-up or 18 months from shipment, whichever occurs first.

B. Provide a full parts warranty by the equipment manufacturer for five years, effective from date of factory start-up and certification.

C. Provide a compressor parts warranty by the equipment manufacturer for seven years, effective from date of factory start-up and certification.

PART 2 - PRODUCTS

2.1 GENERAL

A. Provide an indoor wall-mounted, factory assembled, pre-charged, pre-wired, tested and ready to operate air conditioning unit.

2.2 Approved Manufacturers

A. Daikin

B. Trane/Mitsubishi

C. Hitachi

D. Toshiba

E. Samsung

F. LG

G. York/JCI

2.3 WALL-MOUNTED INDOOR UNIT

A. GENERAL

1. The unit shall be a wall-mounted style indoor unit with outlet vane and return inlet grille. The indoor unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, electronic modulating linear expansion device, control circuit board and fan motor. The unit shall have a self-diagnostic function, 3-minute time delay mechanism, an auto restart function, an emergency operation function, a test run switch, and the ability to adjust airflow patterns. Indoor unit and refrigerant pipes shall be charged with dehydrated air before shipment from the factory.

B. UNIT CABINET

1. The cabinet shall be formed from high strength molded high impact, non-metallic material with smooth finish, flat front panel design with access for filter. Cabinet color shall be white. The unit shall be wall mounted by means of a factory supplied, pre-drilled, mounting plate.
2. The cabinet shall be designed so all components are easily accessible for service and maintenance through either the front or rear of the unit. Units that are not fully accessible from front and rear or not serviceable in place shall be unacceptable.

C. FAN AND AIR DISTRIBUTION

1. The air distribution system shall be constructed with a quiet, cross flow direct-drive fan assembly. The single fan motor shall be high-efficiency type, equipped with permanently lubricated bearings. The fan shall be capable of a minimum of three speeds for airflow modulation (High, Med, Low) and Sleep. Dehumidification shall utilize the lower fan speed.
2. Unit shall be provided with an integral, motorized, multi-position, air sweep vane to provide uniform, adjustable vertical air distribution. Air sweep vane operation shall be user selectable using the unit controller.
3. Unit shall be provided with a manually adjustable guide vane for horizontal air distribution.

D. FILTER

1. The filter shall be an integral part of the system, located within the cabinet and serviceable from the front. The filters shall be half-inch thick, washable type.

E. COIL

1. The indoor coil shall be of nonferrous construction with smooth plate fins on copper tubing.
2. The tubing shall have inner grooves for high efficiency heat exchange.
3. All tube joints shall be brazed with phos-copper or silver alloy.
4. The coils shall be pressure tested at the factory.
5. A condensate pan and drain shall be provided under the coil.
6. The unit shall be provided with an integral condensate lift mechanism that will be able to raise drain water 33 inches above the condensate pan.
7. Both refrigerant lines to the indoor units shall be insulated.

F. ELECTRICAL

1. The unit electrical power shall be 208/230 volts, 1-phase, 60 hertz.
2. The system shall be equipped to allow the indoor unit to be powered directly from the associated outdoor unit using 3-wire, 14 gauge AWG connections plus ground.

2.4 MICROPROCESSOR CONTROL

A. The control system shall be microprocessor-based, factory-wired into the system and tested prior to shipment. The wall-mounted control enclosure shall be 4.75" x 4.75" and white in color with include a light-blue LCD providing continuous display of operating status and alarm condition. There shall be a built-in weekly schedule with up to 5 scheduled event settings per day.

B. A 5-key membrane keypad for setpoint/program control, increase/decrease temperature set point, fan speed selection and unit operation mode shall be located below the display. The controller shall have a built-in temperature sensor. Temperature shall be displayed in either Fahrenheit (°F) or Celsius (°C), and Temperature changes shall be by increments of ±3.6°F (±2°C).

C. The control display shall be field-wired to the control board using factory-supplied thermostat wire with plugs. The control voltage from the wired controller to the indoor unit shall be 12 volts, DC. Field wiring shall run directly from the indoor unit to the wall mounted controller with no splices. Communication cable can be extended to a maximum of 164 feet, between controller and indoor unit.

D. The control shall be able to be programmed for a temperature set point between 64 - 86°F (18 - 30°C) with a sensitivity of ±3.6°F (±2°C).

E. The control system shall prevent compressor short-cycling by a 3-minute timer from compressor stop to the next start.

F. For startup after power failure, the system shall provide automatic restart with a programmable (up to 9.9 minutes in 6-second increments) time delay. Programming can be performed at the wall mounted controller.

G. The control system shall monitor unit operation and activate a visual alarm in the event of an alarm condition.

H. Unit controls shall be capable of interfacing the EMCS via BACnet communication protocol. If BACnet protocol is not a native communication protocol to the factory controls, then a separate gateway shall be provided as required.

2.5 OUTDOOR AIR-COOLED PROP FAN CONDENSING UNIT

A. Condensing unit components shall include a condenser coil, a brush-less digitally controlled variable propeller-type fan, an inverter driven twin rotary compressor, electronic expansion valve, 4-way reversing valve.

B. All components shall be factory-assembled, charged with R-32 or R-454B refrigerant and sealed. No internal piping, brazing, dehydration or charging shall be required.

C. The condenser coil shall be constructed of copper tubes and aluminum fins.

D. The condensing unit shall be designed to operate at a sound level less than 57 dBA.

E. The casing shall be constructed from galvanized steel plate, finished with a white electrostatically applied, thermally fused acrylic or polyester powder coating for corrosion protection. Mounting feet shall be provided and shall be welded to the base of the cabinet and be of sufficient size to afford reliable equipment mount and stability. Easy access shall be afforded to all serviceable parts by means of removable panel sections. The fan grill shall be constructed of polypropylene.

F. The condensing unit shall be furnished with a single DC fan motor. The fan blade shall be of aerodynamic design for quiet operation, and the fan motor bearings shall be permanently lubricated. The outdoor unit shall have horizontal discharge airflow. The fan shall be mounted in front of the coil, pulling air across it from the rear and dispelling it through the front. The fan shall be provided with a raised guard to prevent external contact with moving parts.

G. The condensing unit coil shall be of copper tubing with louvered aluminum fins. The coil shall be protected with an integral metal guard. The coil shall have an anti-corrosive coating designed to prevent natural surface corrosion of the aluminum fins, maintaining heat transfer properties of the coil and extending service life. Refrigerant flow from the condenser shall be controlled by means of an electronic expansion valve (EEV) metering device. The EEV shall be controlled by a microprocessor step motor.

H. Provide condenser coils with factory applied corrosion resistant epoxy coating utilizing a dip and bake. Coating shall be capable of withstanding minimum 6,000 hour salt spray test in accordance with ASTM B117.

I. The compressor shall be a DC twin-rotor rotary compressor with Variable Speed Inverter Drive Technology. The compressor shall be driven by inverter circuit to control compressor speed. The compressor speed shall dynamically vary to match the room load for significantly increasing the efficiency of the system which shall result in significant energy savings. To prevent liquid from accumulating in the compressor during the off cycle, a minimal amount of current shall be automatically, intermittently applied to the compressor motor windings to maintain sufficient heat to vaporize any refrigerant. No crankcase heater is to be used. The

outdoor unit shall have an accumulator and high-pressure safety switch. The compressor shall be mounted to avoid the transmission of vibration.

2.6 ACCESSORIES

A. The unit shall be provided with a wind baffle low ambient operation kit. The wind baffle shall be constructed on 20 gauge sheet metal and painted to prevent corrosion. Unit shall be able to provide 100% capacity when operating at 0ºF outdoor air temperature and a wind baffle is used.

B. The unit shall be provided with a cooling coil condensate pump. The condensate pump shall be complete with integral float switch, pump, motor assembly and reservoir.

C. The unit shall be provided with a BACnet gateway for integration with the EMCS.

D. The outdoor unit shall be provided with a full guard package and condenser coil hail guards.

2.7 Refrigerant Leak Detection

A. Indoor units shall be provided with factory installed leak detection system with sufficient quantity of refrigerant detection sensors to detect refrigerant leaks throughout the equipment cabinet.

B. When the system detects a leak, the unit controller shall automatically initiate mitigation actions to prevent excessive refrigerant concentrations within occupied spaces.

PART 3 - EXECUTION

3.1 INSTALLATION OF AIR CONDITIONING UNIT

A. General

1. Install air conditioning unit in accordance with manufacturer's installation instructions. Install unit plumb and level, firmly anchored in location indicated, and maintain manufacturer’s recommended clearances.
2. Refer to specification 230200 – Part 1 for anchorage requirements for roof mounted equipment.
3. Install unit and all field mounted accessories in accordance with NFPA 90A and NFPA 90B.

B. Electrical Wiring

1. Install and connect electrical devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer’s electrical connection diagram submittal to electrical contractor. Install and wire per local and national codes.

C. Piping Connections

1. Install and connect devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer's piping connection diagram submittal to piping contractor.

D. Drain Water Piping

1. Connect drain line to air conditioning unit. Unit drain shall be trapped internally.

E. Field-Supplied Pans

1. A field-supplied pan with drain shall be installed beneath indoor cooling units installed above a ceiling, in a mechanical mezzanine, or in an attic space, and below heat pumps. Drain pan shall be galvanized steel and shall slope at a minimum of 1/8" per foot to drain connection. The drain pan shall extend 3" larger on all sides than unit footprint.
2. Drain pans provided below heat pumps shall be provided with a drain line routed to the nearest drain or as indicated on plans.
3. Drain pans provided below indoor cooling units shall be provided with a condensate overflow switch or separate drain line.

a. If a condensate overflow switch is provided, the overflow switch shall include the following features and adhere to the following installation and operation:

1) Condensate overflow switch features:

a) UL 508 listing
b) 24 volt power connection
c) Plenum rated casing and wiring when installed in a plenum used for return air

2) The condensate overflow switch shall be installed in the secondary drain pan and shall shut down the entire unit when the primary drain line becomes restricted. The switch shall be adjusted as required to ensure that the switch engages prior to the drain pan overflowing. At a minimum, unit shut down shall:

a) De-energize supply fan
b) Close outside air damper
c) Generate an alarm locally at the unit and remotely through the EMCS

3.2 FIELD QUALITY CONTROL

A. Startup air conditioning unit in accordance with manufacturer's startup instructions. Test controls and demonstrate compliance with requirements. Provide system start-up services by manufacturer's authorized service representative confirming all system equipment and components have been installed in accordance with the manufacturer's written instructions. Provide formal report for engineer and owner review and approval.

END OF SECTION 238126

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SECTION 260200 - BASIC MATERIALS AND METHODS FOR ELECTRICAL

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all Work herein.

B. The Contract Drawings indicate the extent and general arrangement of the systems. If any departure from the Contract Drawings are deemed necessary by the Contractor, details of such departures and the reasons, therefore, shall be submitted to the Architect for approval as soon as practicable. No such departures shall be made without the prior written approval of the Architect.

1.2 SCOPE OF WORK

A. The Work included under this Contract consists of the furnishing and installation of all equipment and material necessary and required to form the complete and functioning systems in all of its various phases, all as shown on the accompanying Drawings and/or described in these Specifications. The contractor shall review all pertinent drawings, including those of other contracts prior to commencement of Work.

B. This Division requires the furnishing and installing of all items Specified herein, indicated on the Drawings or reasonably inferred as necessary for safe and proper operation; including every article, device or accessory (whether or not specifically called for by item) reasonably necessary to facilitate each system's functioning as indicated by the design and the equipment specified. Elements of the work include, but are not limited to, materials, labor, supervision, transportation, storage, equipment, utilities, all required permits, licenses and inspections. All work performed under this Section shall be in accordance with the Project Manual, Drawings and Specifications and is subject to the terms and conditions of the Contract.

C. The approximate locations of Electrical items are indicated on the Drawings. These Drawings are not intended to give complete and accurate details in regard to location of outlets, apparatus, 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 Engineer, who reserves the right to make any reasonable changes in the locations indicated without additional cost to the Owner.

D. 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.

E. All discrepancies within the Contract Documents discrepancies between the Contract Documents and actual job-site conditions shall be reported to the Owner or Engineer 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 more costly of the discrepancy shall be bid. All labor and materials required to perform the work described shall be included as part of this Contract.

F. It is the intention of this Section of the Specifications to outline minimum requirements to furnish the Owner with a turn-key and fully operating system in cooperation with other trades.

G. It is the intent of the above "Scope" to give the Contractor a general outline of the extent of the Work involved; however, it is not intended to include each and every item required for the Work. Anything omitted from the "Scope" but shown on the Drawings, or specified later, or necessary for a complete and functioning electrical system shall be considered a part of the overall "Scope".

H. The Contractor shall rough-in fixtures and equipment furnished by others from rough-in and placement drawings furnished by others. The Contractor shall make final connection to fixtures and equipment furnished by others.

I. Contractor shall participate in the commissioning process; including but not limited to meeting attendance, completion of checklists and participation in functional testing.

1.3 RELATED SECTIONS

A. General Conditions

B. Supplementary Conditions

C. Division One

1.4 COOPERATION WITH TRADES

A. Cooperation with trades of adjacent, related, or affected materials or operations shall be considered a part of this work in order to affect timely and accurate placing of work and bring together in proper and correct sequence, the work of such trades.

1.5 REFERENCES

A. National Electrical Code (NEC)

B. American Society for Testing and Materials (ASTM)

C. Underwriter's Laboratories, Inc. (UL)

D. Insulated Cable Engineer's Association (ICEA).

E. National Electrical Manufacturer's Association (NEMA).

F. Institute of Electrical and Electronic's Engineers (IEEE).

G. American National Standards Institute (ANSI).

H. National Fire Protection Association (NFPA).

I. International Energy Conservation Code (IECC).

1.6 COMPLETE FUNCTIONING OF WORK

A. All work fairly implied as essential to the complete functioning of the electrical systems shown on the Drawings and Specifications shall be completed as part of the work of this Division unless specifically stated otherwise. It is the intention of the Drawings and Specifications to establish the types of the systems, but not set forth each item essential to the functioning of the system. In case of doubt as to the work intended, or in the event of amplification or clarification thereof, the Contractor shall call upon the Architect for supplementary instructions, Drawings, etc.

B. Contractor shall review all pertinent Drawings and adjust his work to all conditions shown there on. Discrepancies between Plans, Specifications, and actual field conditions shall be brought to the prompt attention of the Architect.

1. Approximate location of transformers, feeders, branch circuits, outlets, lighting and power panels, outlets for special systems, etc., are indicated on the Drawings. However, the Drawings do not give complete and accurate detailed locations of such outlets, conduit runs, etc., and exact locations must be determined by actual field measurement. Such locations will, at all times, be subject to the approval of the Architect.
2. Communicate with the Architect and secure his approval of any outlet (light fixture, receptacle, switch, etc.) location about which there may be the least question. Outlets obviously placed in a location not suitable to the finished room or without specific approval, shall be removed and relocated when so directed by the Architect. Location of light fixtures shall be coordinated with reflected ceiling plans.

C. Additional coordination with mechanical contractor may be required to allow adequate clearances of mechanical equipment, fixtures and associated appurtenances. Contractor to notify Architect and Engineer of unresolved clearances, conflicts or equipment locations.

1.7 SCHEMATIC NATURE OF CONTRACT DOCUMENTS

A. 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 approved shop drawings.

1.8 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 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 electrical work shall be required to be licensed. Onsite supervision, journeyman shall have minimum of journeyman license. Helpers, apprentices shall have minimum of apprentice license.

1.9 DATE OF 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 One for additional requirements.

B. The date of final acceptance shall be documented in writing and signed by the architect, owner and contractor.

1.10 DEFINITIONS AND SYMBOLS

A. General Explanation: A substantial amount of construction and Specification language constitutes definitions for terms found in other Contract Documents, including Drawings which must be recognized as diagrammatic and schematic in nature and not completely descriptive of requirements indicated thereon. Certain terms used in Contract Documents are defined generally in this article, unless defined otherwise in Division 1.

B. Definitions and explanations of this Section are not necessarily either complete or exclusive but are general for work to the extent not stated more explicitly in another provision of the Contract Documents.

C. Indicated: The term "Indicated" is a cross-reference to details, notes or schedules on the Drawings, to other paragraphs or schedules in the Specifications and to similar means of recording requirements in Contract Documents. Where such terms as "Shown", "Noted", "Scheduled", "Specified" and "Detailed" are used in lieu of "Indicated", it is for the purpose of helping the reader locate cross-reference material, and no limitation of location is intended except as specifically shown.

D. Directed: Where not otherwise explained, terms such as "Directed", "Requested", "Accepted", and "Permitted" mean by the Architect or Engineer. However, no such implied meaning will be interpreted to extend the Architect's or Engineer's responsibility into the Contractor's area of construction supervision.

E. Reviewed: Where used in conjunction with the Engineer's response to submittals, requests for information, applications, inquiries, reports and claims by the Contractor the meaning of the term "Reviewed" will be held to limitations of Architect's and Engineer's responsibilities and duties as specified in the General and Supplemental Conditions. In no case will "Reviewed" by Engineer be interpreted as a release of the Contractor from responsibility to fulfill the terms and requirements of the Contract Documents.

F. Furnish: Except as otherwise defined in greater detail, the term "Furnish" is used to mean supply and deliver to the project site, ready for unloading, unpacking, assembly, installation, etc., as applicable in each instance.

G. Install: Except as otherwise defined in greater detail, the term "Install" is used to describe operations at the project site including unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protection, cleaning and similar operations, as applicable in each instance.

H. Provide: Except as otherwise defined in greater detail, the term "Provide" is used to mean "Furnish and Install", complete and ready for intended use, as applicable in each instance.

I. Installer: Entity (person or firm) engaged by the Contractor or its subcontractor or Sub-contractor for performance of a particular unit of work at the project site, including unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protection, cleaning and similar operations, as applicable in each instance. It is a general requirement that such entities (Installers) be expert in the operations they are engaged to perform.

J. Imperative Language: Used generally in Specifications. Except as otherwise indicated, requirements expressed imperatively are to be performed by the Contractor. For clarity of reading at certain locations, contrasting subjective language is used to describe responsibilities that must be fulfilled indirectly by the Contractor, or when so noted by other identified installers or entities.

K. Minimum Quality/Quantity: In every instance, the quality level or quantity shown or specified is intended as minimum quality level or quantity of work to be performed or provided. Except as otherwise specifically indicated, the actual work may either comply exactly with that minimum (within specified tolerances) or may exceed that minimum within reasonable tolerance limits. In complying with requirements, indicated or scheduled numeric values are either minimums or maximums as noted or as appropriate for the context of the requirements. Refer instances of uncertainty to Owner or Engineer via a request for information (RFI) for decision before proceeding.

L. Abbreviations and Symbols: The language of Specifications and other Contract Documents including Drawings is of an abbreviated type in certain instances and implies words and meanings which will be appropriately interpreted. Actual word abbreviations of a self-explanatory nature have been included in text of Specifications and Drawings. Specific abbreviations and symbols 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 or on a Legend and Symbol Drawing. Trade and industry association names and titles of generally recognized industry 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 Contract Documents so indicate. Except as otherwise indicated, graphic symbols and abbreviations used on Drawings and in Specifications are those recognized in construction industry for indicated purposes. Where not otherwise noted symbols and abbreviations are defined by 1993 ASHRAE Fundamentals Handbook, chapter 34 "Abbreviations and Symbols", ASME and ASPE published standards.

1.11 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to the project properly identified with names, model numbers, types, grades, compliance labels, and other information needed for identification.

B. Deliver products to the project at such time as the project is ready to receive the equipment, pipe or duct properly protected from incidental damage and weather damage.

C. Damaged equipment shall be promptly removed from the site and new, undamaged equipment shall be installed in its place promptly with no additional charge to the Owner.

1.12 SUBMITTALS

A. Coordinate with Division 01 for submittal timetable requirements, unless noted otherwise within thirty (30) days after the Contract is awarded. The Contractor shall submit an electronic copy of a complete set of shop drawings and complete data covering each item of equipment or material. The submittal of each item requiring a submittal must be received by the Architect or Engineer within the above thirty day period. The Architect or Engineer shall not be responsible for any delays or costs incurred due to excessive shop drawing review time for submittals received after the thirty (30) day time limit. The Architect and Engineer will retain a copy of all shop drawings for their files. All literature pertaining to items subject to Shop Drawing submittal shall be submitted at one time. Submittals shall be placed in one electronic file in PDF 8.0 format and bookmarked for individual specification sections. Individual electronic files of submittals for individual specifications shall not be permitted. Each submittal shall include the following items:

1. A cover sheet with the names and addresses of the Project, Architect, MEP Engineer, General Contractor and the Subcontractor making the submittal. The cover sheet shall also contain the section number covering the item or items submitted and the item nomenclature or description.
2. An index page with a listing of all data included in the Submittal.
3. A list of variations page with a listing all variations, including unfurnished or additional required accessories, items or other features, between the submitted equipment and the specified equipment. If there are no variations, then this page shall state "NO VARIATIONS". Where variations affect the work of other Contractors, then the Contractor shall certify on this page that these variations have been fully coordinated with the affected Contractors and that all expenses associated with the variations will be paid by the submitting Contractor. This page will be signed by the submitting Contractor.
4. Equipment information including manufacturer's name and designation, size, performance and capacity data as applicable. All applicable Listings, Labels, Approvals and Standards shall be clearly indicated.
5. Dimensional data and scaled drawings as applicable to show that the submitted equipment will fit the space available with all required Code and maintenance clearances clearly indicated and labeled at a minimum scale of 1/4" = 1'-0", as required to demonstrate that the alternate or substituted product will fit in the space available.
6. Identification of each item of material or equipment matching that indicated on the Drawings.
7. Sufficient pictorial, descriptive and diagrammatic data on each item to show its conformance with the Drawings and Specifications. Any options or special requirements

or accessories shall be so indicated. All applicable information shall be clearly indicated with arrows or another approved method.

8. Additional information as required in other Sections of this Division.
9. Certification by the General Contractor and Subcontractor that the material submitted is in accordance with the Drawings and Specifications, signed and dated in long hand. Submittals that do not comply with the above requirements shall be returned to the Contractor and shall be marked "REVISE AND RESUBMIT".

B. Refer to Division 1 for additional information on shop drawings and submittals.

C. Equipment and materials submittals and shop drawings will be reviewed for compliance with design concept only. It will be assumed that the submitting Contractor has verified that all items submitted can be installed in the space allotted. Review of shop drawings and submittals shall not be considered as a verification or guarantee of measurements or building conditions.

D. Where shop drawings and submittals are marked "REVIEWED", the review of the submittal does not indicate that submittals have been checked in detail nor does it in any way relieve the Contractor from his responsibility to furnish material and perform work as required by the Contract Documents.

E. Shop drawings shall be reviewed and returned to the Contractor with one of the following categories indicated:

1. REVIEWED: Contractor need take no further submittal action, shall include this submittal in the O&M manual and may order the equipment submitted on.
2. REVIEWED AS NOTED: Contractor shall submit a letter verifying that required exceptions to the submittal have been received and complied with including additional accessories or coordination action as noted and shall include this submittal and compliance letter in the O&M manual. The contractor may order the equipment submitted on at the time of the returned submittal providing the Contractor complies with the exceptions noted.
3. NOT APPROVED: Contractor shall resubmit new submittal on material, equipment or method of installation when the alternate or substitute is not approved, the Contractor will automatically be required to furnish the product, material or method named in the Specifications and/or drawings. Contractor shall not order equipment that is not approved. Repetitive requests for substitutions will not be considered.
4. REVISE AND RESUBMIT: Contractor shall resubmit new submittal on material, equipment or method of installation when the alternate or substitute is marked revise and resubmit, the Contractor will automatically be required to furnish the product, material or method named in the Specifications and/or provide as noted on previous shop drawings. Contractor shall not order equipment marked revise and resubmit. Repetitive requests for substitutions will not be considered.
5. CONTRACTOR'S CERTIFICATION REQUIRED: Contractor shall resubmit submittal on material, equipment or method of installation. The Contractor's stamp is required stating the submittal meets all conditions of the contract documents. The stamp shall be signed by the General Contractor. The submittal will not be reviewed if the stamp is not placed and signed on all shop drawings.
6. MANUFACTURER NOT AS SPECIFIED: Contractor shall resubmit new submittal on material, equipment or method of installation when the alternate or substitute is marked manufacturer not as specified, the Contractor will automatically be required to furnish the

product, material or method named in the specifications. Contractor shall not order equipment where submittal is marked manufacturer not as specified. Repetitive requests for substitutions will not be considered.

F. Materials and equipment which are purchased or installed without shop drawing review shall be at the risk of the Contractor and the cost for removal and replacement of such materials and equipment and related work which is judged unsatisfactory by the Owner or Engineer for any reason shall be at the expense of the Contractor. The responsible Contractor shall remove the material and equipment noted above and replace with specified equipment or material at his own expense when directed in writing by the Architect or Engineer.

G. Shop Drawing Submittals shall be complete and checked prior to submission to the Engineer for review.

H. Furnish detailed shop drawings, descriptive literature, table of contents listing all items being submitted at the beginning of each submittal package, physical data and a specification critique for each section indicating "compliance" and/or "variations" for the following items:

1. Lighting Fixtures
2. Lighting Contactors
3. Conduit and Fittings
4. Wire

I. Refer to each specification section for additional requirements.

1.13 OPERATION AND MAINTENANCE MANUALS

A. Prepare maintenance manuals in accordance with Division 1 and in addition to the requirements specified in Division 1, include the following information for equipment items:

1. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.
2. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions.
3. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
4. Servicing instructions and lubrication charts and schedules.

1.14 COORDINATION DRAWINGS

A. Prepare coordination drawings to a scale of 1/4"=1'-0" or larger; detailing major elements, components, and systems of mechanical equipment and materials in relationship with other systems, installations, and building components. Indicate locations where space is limited for installation and access and where sequencing and coordination of installations are of importance to the efficient flow of the Work, including (but not necessarily limited to) the following:

1. Indicate the proposed locations of pipe, duct, equipment, and other materials. Include the following:

    a. Wall and type locations.
    b. Clearances for installing and maintaining insulation.
    c. Locations of light fixtures and sprinkler heads.
    d. Clearances for servicing and maintaining equipment, including tube removal, filter removal, and space for equipment disassembly required for periodic maintenance.
    e. Equipment connections and support details.
    f. Exterior wall and foundation penetrations.
    g. Routing of storm and sanitary sewer piping.
    h. Fire-rated wall and floor penetrations.
    i. Sizes and location of required concrete pads and bases.
    j. Valve stem movement.
    k. Structural floor, wall and roof opening sizes and details.

2. Indicate scheduling, sequencing, movement, and positioning of large equipment into the building during construction.
3. Prepare floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.
4. Prepare reflected ceiling plans to coordinate and integrate installations, air distribution devices, light fixtures, communication systems components, and other ceiling-mounted items.

B. This Contractor shall be responsible for coordination of all items that will affect the installation of the work of this Division. This coordination shall include, but not be limited to: voltage, ampacity, capacity, electrical and piping connections, space requirements, sequence of construction, building requirements and special conditions.

C. By submitting shop drawings on the project, this Contractor is indicating that all necessary coordination has been completed and that the systems, products and equipment submitted can be installed in the building and will operate as specified and intended, in full coordination with all other Contractors and Subcontractors.

1.15 RECORD DRAWINGS

A. Prepare Record Documents in accordance with the requirements of Division 00 and Division 01, in addition to the requirements specified in Division 26.

B. The Contractor shall maintain a separate set of clearly and legibly marked Record Drawings on the job site to record all changes and modifications, including, but not limited to the following: work details, alterations to meet site conditions, and changes made by "Change Order" notices. Mark the drawings with colored pencil(s). These shall be available for review by the Owner, Architect or Engineer during the entire construction stage.

C. The Record Drawings shall be updated concurrently as construction progresses, and in no case less frequently than a daily basis. They shall indicate accurate dimensions for all buried or concealed work, precise locations of all concealed pipe or duct, locations of all concealed

valves, controls and devices and any deviations from the work shown on the Construction Documents. All dimensions shall include at least two dimensions to permanent structure points.

D. Engage the services of a Land Surveyor or Professional Engineer registered in the state in which the project is located as specified herein to record the locations and invert elevations of underground installations.

E. If the Contractor does not keep an accurate set of Record Drawings, the pay request may be altered or delayed at the request of the Architect. Delivery of Record Documents is a condition of final acceptance. Record Drawings shall be furnished in addition to Shop Drawings.

F. The Contractor shall submit an electronic copy of the record documents in PDF format and one (1) full size set of Record Drawing prints to the Architect or Engineer for review prior to scheduling the final inspection at the completion of the work. The drawings shall have the name(s) and seal(s) of the Engineer(s) removed or blanked out and shall be clearly marked and signed on each sheet as follows:

CERTIFIED RECORD DRAWINGS

DATE:

(NAME OF GENERAL CONTRACTOR)

BY: _____

(SIGNATURE)

(NAME OF SUBCONTRACTOR)

BY: _____

(SIGNATURE)

1.16 CERTIFICATIONS AND TEST REPORTS

A. Submit a detailed schedule for completion and testing of each system indicating scheduled dates for completion of system installation and outlining tests to be performed and schedule date for each test. This detailed completion and test schedule shall be submittal at least 90 days before the projected Project completion date.

B. Test result reporting forms shall be submitted for review no later than the date of the detailed schedule submitted.

C. Submit 4 copies of all certifications and test reports to the Architect or Engineer for review adequately in advance of completion of the Work to allow for remedial action as required to correct deficiencies discovered in equipment and systems.

D. Certifications and test reports to be submitted shall include, but not be limited to those items outlined in Section of Division 26.

1.17 MAINTENANCE MANUALS

A. Coordinate with Division 1 for maintenance manual requirements, unless noted otherwise bind together in “D ring type” binders by National model no. 79-883 or equal, binders shall be large enough to allow 1/4” of spare capacity. Three (3) sets of all approved shop drawing submittals, fabrication drawings, bulletins, maintenance instructions, operating instructions and parts exploded views and lists for each and every piece of equipment furnished under this Specification. All sections shall be typed and indexed into sections and ed for easy reference and shall utilize the individual specification section numbers shown in the Electrical Specifications as an organization guideline. Bulletins containing information about equipment that is not installed on the project shall be properly marked up or stripped and reassembled. All pertinent information required by the Owner for proper operation and maintenance of equipment supplied by Division 26 shall be clearly and legibly set forth in memoranda that shall, likewise, be bound with bulletins.

B. Prepare maintenance manuals in accordance with Special Project Conditions, in addition to the requirements specified in Division 26, include the following information for equipment items:

1. Identifying names, name tags, designations and locations for all equipment.
2. Fault Current calculations and Coordination Study.
3. Reviewed shop drawing submittals with exceptions noted compliance letter.
4. Fabrication drawings.
5. Equipment and device bulletins and data sheets clearly highlighted to show equipment installed on the project and including performance curves and data as applicable, i.e., description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and model numbers of replacement parts.
6. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions.
7. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions, servicing instructions and lubrication charts and schedules.
8. Equipment name plate data.
9. Wiring diagrams.
10. Exploded parts views and parts lists for all equipment and devices.
11. Color coding charts for all painted equipment and conduit.
12. Location and listing of all spare parts and special keys and tools furnished to the Owner.
13. Furnish recommended lubrication schedule for all required lubrication points with listing of type and approximate amount of lubricant required.

C. Refer to Division 1 for additional information on Operating and Maintenance Manuals.

D. Operating and Maintenance Manuals shall be turned over to the Owner or Engineer a minimum of 14 working days prior to the beginning of the operator training period.

1.18 OPERATOR TRAINING

A. The Contractor shall furnish the services of factory trained specialists to instruct the Owner's operating personnel. The Owner's operator training shall include 12 hours of onsite training in three 4 hour shifts.

B. 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.

C. Refer to other Division 26 Sections for additional Operator Training requirements.

1.19 SITE VISITATION

A. Visit the site of the proposed construction in order to fully understand the facilities, difficulties and restriction attending the execution of the work.

B. Before submitting a bid, it will be necessary for each Contractor whose work is involved to visit the site and ascertain for himself the conditions to be met therein in installing his work and make due provision for same in his bid. It will be assumed that this Contractor in submitting his bid has visited the premises and that his bid covers all work necessary to properly install the equipment shown. Failure on the part of the Contractor to comply with this requirement shall not be considered justification for the omission or faulty installation of any work covered by these Specifications and Drawings.

C. Understand the existing utilities from which services will be supplied; verify locations of utility services and determine requirements for connections.

D. Determine in advance that equipment and materials proposed for installation fit into the confines indicated.

1.20 WARRANTY

A. The undertaking of the work described in this Division shall be considered equivalent to the issuance, as part of this work, of a specific guarantee extending one year beyond the date of completion of work and acceptance by Owner, against defects in materials and workmanship. Materials, appliances and labor necessary to effect repairs and replacement so as to maintain said work in good functioning order shall be provided as required. Replacements necessitated by normal wear in use or by Owner's abuse are not included under this guarantee.

B. All normal and extended warranties shall include parts, labor, miscellaneous materials, travel time, incidental expenses, freight/shipping, refrigerant, oils, lubricants, belts, filters and any expenses related to service call required to diagnose warranty problems.

1.21 TRANSFER OF ELECTRONIC FILES

A. Project documents are not intended or represented to be suitable for reuse by Architect/Owner or others on extensions of this project or on any other project. Any such reuse or modification without written verification or adaptation by Engineer, as appropriate for the specific purpose intended, will be at Architect/Owner's risk and without liability or legal exposure to Engineer or its consultants from all claims, damages, losses and expense, including attorney's fees arising out of or resulting thereof.

B. Because data stored in electric media format can deteriorate or be modified inadvertently, or otherwise without authorization of the data's creator, the party receiving the electronic files agrees that it will perform acceptance tests or procedures within sixty (60) days of receipt, after which time the receiving party shall be deemed to have accepted the data thus transferred to be acceptable. Any errors detected within the sixty (60) day acceptance period will be corrected by the party delivering the electronic files. Engineer is not responsible for maintaining documents stored in electronic media format after acceptance by the Architect/Owner.

C. When transferring documents in electronic media format, Engineer makes no representations as to the long-term compatibility, usability or readability of documents resulting from the use of software application packages, operating systems, or computer hardware differing from those used by Engineer at the beginning of the Project.

D. Any reuse or modifications will be Contractor's sole risk and without liability or legal exposure to Architect, Engineer or any consultant.

E. The Texas Board of Architectural Examiners (TBAE) has stated that it is in violation of Texas law for persons other than the Architect of record to revise the Architectural drawings without the Architect's written consent.

1. It is agreed that "MEP" hard copy or computer-generated documents will not be issued to any other party except directly to the Architect/Owner. The contract documents are contractually copyrighted and cannot be used for any other project or purpose except as specifically indicated in AIA B-141 Standard Form of Agreement Between Architect and Owner.
2. If the client, Architect or Owner of the project requires electronic media for "record purposes," then AutoCAD/ Revit documents will be prepared by Engineer on electronic media such as removable memory devices, flash drives or CD's. These documents can also be submitted via file transfer protocols. AutoCAD/ Revit files will be submitted with all title block references intact to permit the end user to only view and plot the drawings. Revisions will not be permitted in this configuration.
3. At the Architect/Owner's request, Engineer will assist the Contractor in the preparation of the submittals and prepare one copy of AutoCAD/ Revit files on electronic media or submit through file transfer protocols. The electronic media will be prepared with all indicia of documents ownership removed. The electronic media will be prepared in a ".rvt" or ".dwg" format to permit the end user to revise the drawings.

PART 2 - PRODUCTS

2.1 SUBSTITUTIONS

A. The names and manufacturers and model numbers have been used in the Contract documents to establish types of equipment and standards of quality. Where more than one manufacturer is named for a specific item of equipment, only one of the specified manufacturers will be considered for approval. Where only one manufacturer is mentioned with the phrase "or approved equal", Contractor may submit an alternate manufacturer for consideration, provided the following conditions are met:

1. Submit alternate equipment with complete descriptive data in shop drawing form. Provide sample of equipment upon request for review by Architect. Samples will be returned if requested in writing.
2. Alternate equipment must be equal from the standpoint of materials, construction and performance.
3. Alternate submittal must be presented to the Engineer/Architect ten (10) days prior to bid date for approval.

B. The Architect and Engineer shall be the sole judge of quality and equivalence of equipment, materials and methods.

2.2 PRODUCT LISTING

A. Products used on this project shall be listed by Underwriters' Laboratories.

2.3 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.

2.4 ESCUTCHEONS

A. Provide heavy chrome or nickel plated plates, of approved pattern, on conduit passing through walls, floors and ceilings in finished areas. Where conduit passes through a sleeve, no point of the conduit shall touch the building construction. Caulk around such conduit with sufficient layers of two hour rated firesafing by Thermafiber 4.0 P.C.F. density, U.S.G. fire test 4/11/78 and seal off openings between conduit and sleeves with non-hardening mastic prior to application of escutcheon plate. Escutcheons shall be Gravler Sure-Lock or approved equal.

2.5 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 Code requirements. Physical dimensions and arrangement of equipment shall be subject to the approval of the Architect.

2.6 ELECTRICAL SYSTEM IDENTIFICATION

A. Underground Cable Identification: Bury a continuous, preprinted, bright colored plastic ribbon cable marker with each underground cable (or group of cables), regardless of whether conductors are in conduit, duct bank, or direct buried. Locate each directly over cables, 6 to 8 inches below finished grade.

B. 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. Care shall be taken not to obliterate this nameplate in any way. Provide black back plate with white letters and numbers for normal equipment. Provide red back plate with white letters and numbers for optional emergency equipment. Provide yellow back plate with white letters and numbers for Life safety equipment.
2. A black-white-black laminated plastic engraved identifying nameplate shall be secured by stainless steel screws to each automatic transfer switch, switchboard, distribution panel, motor control center, motor starter panels and panelboards.

a. Identifying nameplates shall have ¼ inch high engraved letters and shall contain the following information:
   1) Name
   2) Voltage
   3) Phase
   4) "3" or "4" wire, and
   5) Where it is fed from.

b. An example of a panelboard nameplate is:
   Center Panel – 1HB

   480/277 volt, 3 phase, 4 wire

   Center Fed from DP2

c. An example of an automatic transfer switch nameplate is:
   Center ATS #2

480/277 volt, 3 phase, 4 wire, 4 pole

Center Fed from MSB and DPE

3. Each feeder device in a switchboard, distribution panel, and motor control center device shall have a nameplate showing the load served in ½ inch high engraved letters.
4. A black-white-black laminated plastic engraved identifying nameplate shall be secured by screws to each transformer, safety switch, disconnect switch, individual motor starter, enclosed circuit breaker, wireway, and terminal cabinet.

    a. Identifying nameplates shall have 1/4 inch high engraved letters and shall indicate the equipment served.
    b. An example of a disconnect switch is: AHU-1.

5. Prohibited Markings: Markings which are intended to identify the manufacturer, vendor, or other source from which the material has been obtained are prohibited for installation within public, tenant, or common areas within the project. Also, prohibited are materials or devices which bear evidence that markings or insignias have been removed. Certification, testing (example, Underwriters' Laboratories, Inc.), and approval labels are exceptions to this requirement.
6. Warning Signs: Provide warning signs where there is hazardous exposure associated with access to or operation of electrical facilities. Provide text of sufficient clarity and lettering of sufficient size to convey adequate information at each location, mount permanently in an appropriate and effective location. Comply with recognized industry standards for color and design.
7. Operational Tags: Where needed for proper and adequate information on operation and maintenance of electrical system, provide tags of plasticized card stock, either preprinted or hand printed. Tags shall convey the message, example: "DO NOT OPEN THIS SWITCH WHEN BURNER IS OPERATING."

C. Identification of Wiring Devices

1. Contractor shall indicate the circuit serving each wiring device. Provide a typewritten label located on the inside face of the coverplate for all recessed mounted devices and on the outside face of the coverplate on all surface mounted devices.

PART 3 - EXECUTION

3.1 EXCAVATING AND BACKFILLING

A. Trenching and backfilling and other earthwork operations required to install the facilities specified herein shall conform to the applicable requirements of Division 2 (95% of maximum standard density). Where trenching or excavation is required in improved areas, the backfill shall be compacted to a condition equal to that of adjacent undisturbed earth and the surface of the area restored to the condition existing prior to trenching or excavating operations. Provide a minimum of 3" of sand underneath all conduits. The plans indicate information pertaining to surface and sub-surface obstructions; however, this information is not guaranteed. Should obstructions be encountered whether or not shown, the Contractor shall alter routing of new

work, reroute existing lines, remove obstructions where permitted, or otherwise perform whatever work is necessary to satisfy the purpose of new work and leave existing surfaces and structures in a satisfactory and serviceable condition. All work shall comply with OSHA Standards.

3.2 WORKMANSHIP AND CONCEALMENT

A. The work of this Section shall be performed by workman skilled in their trade. Installation shall be consistent in completeness whether concealed or exposed. Each item of electrical work shall be concealed in walls, chases, under floors and above ceilings except:

1. Where shown to be exposed.
2. Where exposure is necessary to the proper function.

3.3 SLEEVES, CUTTING AND PATCHING

A. This section shall be responsible for placing sleeves for all conduit passing through walls, partitions, sound walls, beams, floors, roof, etc. Sleeves through below-grade walls shall use water-tight fitting manufactured by O-Z/Gedney.

B. Contractor shall install underground raceways including but not limited to feeders, service laterals, branch circuit and telecommunications. Contractor shall saw cut existing hard surfaces, when required for installation. Contractor shall patch surface to match existing conditions. Contractor shall replace all landscaping material when raceways are installed in these areas. Submit proposed method for patching for review.

C. All cutting and patching will be done under another Division, but this Section will be responsible for timely performance of this work and layout of holes and setting sleeves.

D. All un-used sleeves shall be sealed with 2 hour UL approved fire sealant manufactured by “3M” or approved equal.

E. Refer to 26 05 33 for additional requirements.

3.4 ELECTRICAL GEAR

A. Install all electrical equipment in accordance with the National Electrical Code and as shown on the drawings.

B. Lighting contactors, time clocks, fire alarm equipment, security equipment disconnect switches, etc. mounted in mechanical/electrical rooms shall be mounted at a working height not requiring a ladder when wall space is available. Installation of these devices at greater elevations shall be approved by the Engineer. Contractor shall provide a coordination sketch of each mechanical/electrical room noting locations and mounting heights of all electrical devices (note bottom and top elevations) shown to be installed. Sketches shall be provided to the Engineer for review and the general contractor for coordination with other trades working in these rooms.

C. Fire retardant back boards secured to drywall studs may be used for contactors, time clocks, fire alarm equipment, security equipment, and disconnect switches 60 amp or smaller. All other wall mounted devices shall be mounted to unistrut. Unistrut shall be securely mounted to the floor and structural ceiling. Toggle bolts or anchor bolts attached to drywall is not acceptable.

3.5 CLEANING

A. Clean lighting fixtures and equipment.

B. Touch-up and refinish scratches and marred surfaces on panels, switches, starters, and transformers.

3.6 CORROSIVE AREAS

A. In areas of a corrosive nature, which include but are not limited to the following: pool equipment rooms, cooling towers and areas subject to salt air, etc., provide NEMA 4 X stainless steel or fiberglass reinforced enclosures for contactors, panel boards, controllers, starters, disconnects and materials used as supporting means (i.e. plastibond unistrut, pipe, fittings). The use of spray on coating may be acceptable in some applications.

3.7 TESTS AND INSPECTIONS

A. Tests and inspection requirements shall be coordinated with Division I.

B. Date for final acceptance test shall be sufficiently in advance of completion date of contract to permit alterations or adjustments necessary to achieve proper functioning of equipment prior to contract completion date.

C. Conduct re-tests as directed by Architect on portions of work or equipment altered or adjusted as determined to be necessary by final acceptance test. No resultant delay or consumption of time as a result of such necessary re-test beyond contract completion date shall relieve Contractor of his responsibility under contract.

D. Put circuits and equipment into service under normal conditions, collectively and separately, as may be required to determine satisfactory operation. Demonstrate equipment to operate in accordance with requirements of these specifications. Perform tests in the presence of Architect. Furnish instruments and personnel required for tests.

E. Final Inspection:

1. At the time designated by the Architect, the entire system shall be inspected by the Architect and Engineer. The contractor or his representative shall be present at this inspection.
2. Panelboards, switches, fixtures, etc., shall be cleaned and in operating condition.
3. Certificates and documents required hereinbefore shall be in order and presented to the Architect prior to inspection.

4. Panel covers, junction box covers, etc., shall be removed for visual inspection of the wire, bus bars, etc.
5. After the inspection, any items which are noted as needing to be changed or corrected in order to comply with these specifications and the drawings shall be accomplished without delay.

F. The contractor shall provide a thermographic test using an independent testing laboratory using an infrared scanning device. This test shall include but not limited to all switchboards, distribution panelboards, panelboards, automatic transfer switches and other electrical distribution devices. This test shall be conducted to locate high temperature levels. This test shall be conducted between 3 to 8 months after occupancy, but not beyond the one year warranty period. Submit test to the architect and engineer using test reporting forms. All unacceptable conditions shall be corrected prior to the end of the warranty period.

END OF SECTION 260200

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SECTION 260201 - COORDINATION DRAWINGS

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions 013100 and Supplementary Conditions apply to all Work herein.

1.2 COORDINATION DRAWINGS

A. The Contractor shall take the lead in coordinating the Mechanical, Electrical, Plumbing, Communications, Electronic Safety/Security and Fire Protection systems within the building.

B. The Contractor shall coordinate a three-dimensional (3D) model of the building which includes the Mechanical, Electrical, Plumbing, and Fire Protection systems. The Mechanical, Electrical, Plumbing, and Fire Protection Contractors shall prepare their work and generate 3D models which will be given to the Contractor for coordination. The Contractor will be provided with the REVIT model that was used to generate the contract documents, this file may be used as the background file. The Contractor shall replace the systems drawn with the actual shop drawing models. The Contractor is not limited to using REVIT but may use any 3-D software in generating and combining the coordination model.

C. Submitting the contract drawings as coordination drawings will not be acceptable.

D. The model shall include detailed and accurate representations of all equipment to be installed based upon the reviewed equipment submittals.

E. The Contractor shall hold a 3-D coordination meeting with all sub-contractors present to review the model and discuss coordination of the installation of the building systems.

F. Upon completion of the coordination meeting, the Contractor shall submit the 3-D model and 1/4" scale drawings for review.

G. The model shall detail major elements, components, and systems in relationship with other systems, installations, and building components. Indicate locations where space is limited for installation and access and where sequencing and coordination of installations are of importance to the efficient flow of the Work, including (but not necessarily limited to) the following:

1. Indicate the proposed locations of pipe, duct, equipment, and other materials. Include the following:

    a. Wall and type locations.
    b. Clearances for installing and maintaining insulation.
    c. Locations of light fixtures and sprinkler heads.

d. Clearances for servicing and maintaining equipment, including tube removal, filter removal, and space for equipment disassembly required for periodic maintenance.
e. Equipment connections and support details.
f. Exterior wall and foundation penetrations.
g. Routing of storm and sanitary sewer piping.
h. Fire-rated wall and floor penetrations.
i. Sizes and location of required concrete pads and bases.
j. Valve stem movement.
k. Structural floor, wall and roof opening sizes and details.

2. Indicate scheduling, sequencing, movement, and positioning of large equipment into the building during construction.
3. Prepare floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.
4. Prepare reflected ceiling plans to coordinate and integrate installations, air distribution devices, light fixtures, communication systems components, and other ceiling-mounted items.

H. Sequence of Coordination

1. Below is hierarchy of model elements and the sequencing by which the models will be coordinated:

a. Structural and Architectural model
b. Miscellaneous steel
c. Perform preliminary space allocation
d. Identify hard constraints (locations of access panels, lights, A/V space requirements, etc.)
e. Main and medium pressure ducts from the shaft out
f. Main graded plumbing lines and vents
g. Sprinkler mains and branches
h. Cold and hot water mains and branches
i. Lighting fixtures and plumbing fixtures
j. Smaller sized ducts and flex ducts
k. Smaller size cold water and hot water piping, flex ducts, etc.

I. The Contractor shall not install any item until the coordination has been completed and reviewed by the Construction Manager, Owner, and A/E team.

J. This Contractor shall be responsible for coordination of all items that will affect the installation of the work of this Division. This coordination shall include, but not be limited to voltage, ampacity, capacity, electrical and piping connections, space requirements, sequence of construction, building requirements and special conditions.

K. By submitting shop drawings on the project, this Contractor is indicating that all necessary coordination has been completed and that the systems, products, and equipment submitted can be installed in the building and will operate as specified and intended, in full coordination with all other Contractors and Subcontractors.

END OF SECTION 260201

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SECTION 260313 - ELECTRICAL DEMOLITION FOR REMODELING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. The contractor shall be responsible for loss or damage to the existing facilities caused by him and his workmen and shall be responsible for repairing such loss or damage. The contractor shall send proper notices, make necessary arrangements, and perform other services required for the care, protection and in-service maintenance of all electrical services for the new and existing facilities. The contractor shall erect temporary barricades, with necessary safety devices, as required to protect personnel from injury, removing all such temporary protection upon completion of the work.

B. Outages of services as required by the new installation will be permitted but only at a time approved by the Owner. The contractor shall allow the Owner 2 weeks in order to schedule required outages. The time allowed for outages will not be during normal working hours unless otherwise approved by the Owner. All costs of outages, including overtime charges, shall be included in the contract amount.

C. The contractor shall provide temporary or new services to all existing facilities as required to maintain their proper operation when normal services are disrupted as a result of the work being accomplished under this project.

1.2 RELATED SECTIONS

A. Section 01120 - Alteration Project Procedures.

B. Section 02072 - Minor Demolition for Remodeling.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. Materials and equipment for patching and extending work: As specified in individual Sections.

B. Include in the contract price all rerouting of existing conduits, wiring, outlet boxes, fixtures, etc., and the reconnecting of existing fixtures as necessitated by field conditions to allow the installation of the new systems. Furnish all temporary conduit, wiring, boxes, etc., as required to maintain lighting and power service for the existing areas with a minimum of interruption. Remove wire and conduit back to nearest accessible active junction box and extend to existing homeruns as required.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify field measurements and circuiting arrangements are as shown on Drawings.

B. Verify that abandoned wiring and equipment serve only abandoned facilities.

C. Demolition Drawings are based on casual field observation and existing record documents. Report discrepancies to Owner before disturbing existing installation.

D. Beginning of demolition means installer accepts existing conditions.

3.2 PREPARATION

A. Disconnect electrical systems in walls, floors, and ceilings scheduled for removal.

B. Coordinate utility service outages with Utility Company.

C. 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.

D. Existing Electrical Service: 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 24 hours before partially or completely disabling system. Minimize outage duration. Make temporary connections to maintain service in areas adjacent to work area.

E. Existing Fire Alarm System: Maintain existing system in service until new system is accepted. Disable system only to make switchovers and connections. Notify Owner and local fire service at least 24 hours before partially or completely disabling system. Minimize outage duration. Make temporary connections to maintain service in areas adjacent to work area.

F. Existing Telephone System: Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and connections. Notify Owner and Telephone Utility Company at least 24 hours before partially or completely disabling system. Minimize outage duration. Make temporary connections to maintain service in areas adjacent to work area.

G. Existing Public Address System: 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 the Owner and at least 24 hours before partially or completely disabling system. Minimize outage duration. Make temporary connections to maintain service in areas adjacent to work area.

3.3 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

A. Demolish and extend existing electrical work under provisions of Section 01120, Section 02072, and this Section.

B. Remove, relocate, and extend existing installations to accommodate new construction.

C. Remove abandoned wiring to source of supply.

D. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.

E. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlets, which are not removed.

F. Disconnect and remove abandoned panelboards and distribution equipment.

G. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.

H. Disconnect and remove abandoned luminaires. Remove brackets, stems, hangers, and other accessories.

I. Repair adjacent construction and finishes damaged during demolition and extension work.

J. Maintain access to existing electrical installations which remain active. Modify installation or provide access panel as appropriate.

K. Extend existing installations using materials and methods compatible with existing electrical installations, or as specified.

L. Where existing construction is removed to provide working and extension access to existing utilities, contractor shall remove doors, piping, conduit, outlet boxes, wiring, light fixtures, air conditioning ductwork and equipment, etc., to provide this access and shall reinstall same upon completion of work in the areas affected.

M. Where partitions, walls, floors, or ceilings of existing construction are being removed, all contractors shall remove and reinstall in locations approved by the Architect all devices required for the operation of the various systems installed in the existing construction.

N. During the construction and remodeling, portions of the project shall remain in service. Construction equipment, materials, tools, extension cords, etc., shall be arranged so as to present minimum hazard or interruption to the occupants of the building.

O. Certain work during the demolition phase of construction may require overtime or nighttime shifts or temporary evacuation of the occupants. Coordinate and schedule all proposed down time with the Owner`s Representative at least 72 hours in advance.

P. All existing lighting fixtures, switches, outlets, speakers, materials, equipment and appurtenances not included in the remodel or alteration areas are to remain in place and shall remain in service.

Q. Electrical equipment, outlets, speakers, circuits to mechanical and building systems equipment, etc., which are to remain, but which are served by conduit and/or circuiting that is disturbed by the remodeling work, shall be reconnected in such as manner as to leave it in proper operating condition.

R. Existing branch circuit wiring, which is to be removed, shall be pulled from the raceways and the empty conduit shall be removed to a point of permanent concealment.

S. Within the remodeled or alteration areas where existing walls are being removed, all existing lighting fixtures, switches, receptacles, other materials and equipment and their appurtenances shall be removed, where required by the remodel work either shown or specified.

T. New circuiting indicated to be connected to existing panels shall be connected to "spares" and/or "released" breakers as applicable, or new breakers provided where space is available. Contractor shall verify the existing panel load and feeder capacity prior to adding any additional loads.

U. In all the remodeled areas where existing ceilings are being removed and reinstalled, all existing lighting fixtures, other ceiling mounted devices (i.e. smoked detectors, speakers, etc.) and their appurtenances shall be removed and reinstalled, unless otherwise shown or specified. This also applies to new ceiling installations.

V. Existing lighting fixtures shown to be removed and indicated to be reused, shall be cleaned, repaired, and provided with new accessories as required for the proper operation in their new locations. Provide new lamps and ballast as required.

3.4 CLEANING AND REPAIR

A. Clean and repair existing materials and equipment which remain or are to be reused.

B. Panelboards: 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.

3.5 INSTALLATION

A. Install relocated materials and equipment under the provisions of Section 01120.

3.6 REMOVAL OF MATERIALS

A. The contractor shall modify, remove, and/or relocate all materials and items so indicated on the drawings or required by the installation of new facilities. All removals and/or dismantling shall be conducted in a manner so 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. Materials and/or items scheduled for relocation, and which are damaged during dismantling or reassembly operations shall be repaired and restored to good operative condition. The contractor may, at his discretion and upon the approval of the Owner, substitute new materials and/or items of like design and quality in lieu of materials and/or items to be relocated.

B. All items which are to be relocated shall be carefully removed in reverse to original assembly or placement and protected until relocated. The contractor shall clean, repair, and provide all new materials, fittings, and appurtenances required to complete the relocations and to restore to good operative order. All relocations shall be performed by workmen skilled in the work and in accordance with standard practice of the trades involved.

C. When items scheduled for relocation are found to be in damaged condition before work has been started on dismantling, the contractor shall call the attention of the Owner to such items and receive further instructions before removal. Items damaged in repositioning operations are the contractor`s responsibility and shall be repaired or replaced by the contractor as approved by the Owner, at no additional cost to the Owner.

D. Service lines and wiring to items to be removed, salvaged, or relocated shall be removed to points indicated on the drawings, specified, or acceptable to the Owner. Service lines and wiring not scheduled for reuse shall be removed to the points at which reuse is to be continued or service is to remain. Such services shall be sealed, capped, or otherwise tied-off or disconnected in a safe manner acceptable to the Owner. All disconnections or connections into the existing facilities shall be done in such a manner as to result in minimum interruption of services to adjacent occupied areas. Services to existing areas or facilities which must remain in operation during the construction period shall not be interrupted without prior specific approval of the Owner as hereinbefore specified.

END OF SECTION 260313

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SECTION 260519 - WIRE, CABLE AND RELATED MATERIALS

PART 1 - GENERAL

1.1 SCOPE

A. Provide 600 volt building wire, cable and connectors and 300-volt wire, cable and connectors.

B. WORK INCLUDED: Include the following Work in addition to items normally part of this Section.

1. Wiring for lighting, dimming controls and power.
2. Automatic Control Wiring.
3. Connection of equipment shown.
4. Fire Alarm System.
5. Voice Communications and Sound System.
6. Mineral Insulated Cable (MI)

C. WORK SPECIFIED ELSEWHERE:

1. Heating, ventilating, and air conditioning equipment.
2. Structured cabling system.
3. Coaxial cables

1.2 REFERENCE STANDARDS

A. UL 83 - Thermoplastic-Insulated Wires and Cables

B. ASTM B3 - Standard Specification for Soft or Annealed Copper Wire

C. NFPA 70 - National Electrical Code

D. All wire cable and connectors shall be UL approved.

E. NEMA

F. NEMA Bulletin 119

1.3 ACCEPTABLE MANUFACTURERS

A. 600 VOLT WIRE AND CABLE

1. Southwire
2. Encore
3. Cerro

B. 300 VOLT WIRE AND CABLE

1. Westpenn
2. Beldon
3. Alpha
4. Tappan - Southwire

C. FLEXIBLE CABLE SYSTEMS

1. AFC Modular Cable Systems
2. Kaf-Tech

D. CONNECTORS

1. Ilsco
2. Cooper
3. AMP - TYCO
4. Burndy
5. Ideal
6. 3M
7. O.Z. Gedney
8. Thomas & Betts
9. Buchanan

1.4 SUBMITTALS

A. Shop drawings shall include, but not limited to:

1. Cutsheets of wire, cable and connectors to indicate the performance, fabrication procedures, product variations, and accessories.

1.5 REQUIREMENTS OF REGULATORY AGENCIES WORK IN ACCORDANCE WITH:

A. National Electrical Code.

B. Local, municipal, or state codes that have jurisdiction.

PART 2 - PRODUCTS

2.1 WIRING

A. All wire shall be new and continuous without weld, splice, or joints throughout its length. It must be uniform in cross-section, free from flaws, scales and other imperfections.

B. WIRE MATERIAL: Conductors shall be soft drawn, annealed copper. Aluminum wiring is not acceptable unless otherwise noted on drawings.

C. TYPES:

1. Provide type “THHN/THWN-2” insulation for all buried feeders and service entrance conductors.
2. Provide type “THHN/THWN-2” insulation for all branch circuits and above grade feeders.
3. All wire No. 8 and larger shall be stranded. All wire No. 10 and smaller shall be stranded or solid.
4. Provide type "XHHW" or other 90 degrees insulation wiring for branch circuit wiring installed through continuous rows of fixture bodies.
5. All 300-volt cable including but not limited to telephone, fire alarm, data, CATV and security shall be UL listed for use in return air plenums.
6. All dimming conductors shall be 300-volt, 75 C plenum rated. Dimming conductors shall be solid. Stranded conductors are not acceptable.

D. CONDUCTOR SIZES

1. Feeder conductors shall be sized for a maximum of 2% drop in rated voltage at scheduled load.
2. Branch circuit conductors shall be sized for a maximum 3% drop in the rated voltage to the longest outlet on the circuit.
3. Minimum wire shall be 12 AWG, unless otherwise shown on Drawings or required by Code.
4. Minimum wire size for 0-10v dimming controls shall be 18 AWG for conductors not exceeding 300 feet circuit length (one-way) and 16 AWG for those exceeding 300 feet (one-way).

E. COLOR CODING: No. 6 or larger shall use tape for color coding. No. 8 and smaller wire shall be color coded in accordance with the governing authority requirements or as follows:

1. 120/208 Volt
   Neutral: White

   Phase A: Black

   Phase B: Red

   Phase C: Blue

   Ground: Green

2. 277/480 Volt
   Neutral: Gray

   Phase A: Brown

   Phase B: Purple

   Phase C: Yellow

Ground: Green

2.2 GROUNDING

A. Permanently connect all conduit work, motors, starters, and other electrical equipment to grounding system in accordance with NFPA 70.

PART 3 - EXECUTION

3.1 WIRE

A. Do not pull wire into conduit until Work of an injurious nature is completed. Where two or more circuits run to a single outlet box, each circuit shall be properly tagged. Wyreze or approved equal may be used as a lubricant where necessary.

B. Splices shall be fully made up in outlet boxes with compression crimp-on type splice connectors.

C. Joints and splices will not be permitted in service entrance or in feeders. Joints in branch circuits will be permitted where branch circuits divide, and then shall consist of one through-circuit to which the branch shall be spliced. Joints shall not be left for the fixture hanger to make. Connect joints and splices with Buchanan Series "2000" solderless connectors complete with insulating caps or properly sized twist on wire nuts. “Wago” push-in connectors are not acceptable.

D. All stranded conductors shall be furnished with lugs or connectors.

E. Connectors furnished with circuit breakers or switches shall be suitable for copper wire termination.

F. “Sta-Cons” shall be used to terminate stranded conductors on all switches and receptacles.

G. All stranded #10 and small conductors shall be terminated with an approved solderless terminal if the device or light fixture does not have provisions for clamp type securing of the conductor.

H. The jacket for all travelers used on 3-way and 4-way switches shall be pink.

I. Route conductors for 480Y/277 systems in a separate raceway. Do not combine with 208Y/120 volt or 120/240-volt systems.

J. Emergency circuits shall not be routed with normal conductors.

3.2 BALANCING SYSTEM

A. The load on each distribution and lighting panel shall be balanced to within 10% by proper arrangement of branch circuits on the different phase legs. Provide written documentation showing results. Submit with O & M manuals.

3.3 LOW VOLTAGE WIRING

A. Low voltage wiring, including dimming conductors, shall be plenum rated. All wiring in mechanical rooms, electrical rooms, drywall ceiling, inaccessible areas, underground, plaster ceiling, inside concealed walls areas exposed to occupant view, and other areas subject to physical damage shall be run in conduit.

B. Low voltage wiring shall be routed in separate raceways from power wiring systems.

C. Sleeves shall be placed in the forms of concrete, masonry and fire rated walls, floor slabs and beams, for the passage of wiring. Sleeves should be set in place a sufficient time ahead of the concrete work so as not to delay the work. Sleeves shall be rigid galvanized steel.

D. Provide Caddy J-hooks supported independently from other system to support cable at 4-foot on center or closer if required by manufacturer.

E. Provide a junction box to make up all joints and splices.

F. Provide dimming conductors for all lighting circuits located in spaces with dimmer switches and theatrical lighting as indicated on the drawings and as specified.

3.4 CABLE SUPPORTS

A. Provide cable supports in all vertical raceways in accordance with Article 300-19 of NFPA 70.

3.5 DEFECTS

A. Defects shall include, but are not to limited to, the following:

1. Tripping circuit breakers under normal operation.
2. Improperly connected equipment.
3. Damaged, torn, or skinned insulation.

END OF SECTION 260519

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SECTION 260526 - GROUNDING

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

1.2 SCOPE

A. WORK COMBINED WITH OTHER SECTIONS: Combine the work specified herein with the following Sections to form a single responsibility for the Work:

1. Electrical.
2. Basic materials and methods.

B. Provide electrical service, equipment and wiring device grounding as shown, scheduled and as specified.

C. The types of grounding include, but not limited to, the grounding bonding of all equipment devices, building steel piping, and as required by the National Electrical Code, Local Inspection Department and Power Company.

1.3 STANDARDS

A. National Electrical Code (NFPA-70)

B. Local municipal and State codes that have jurisdiction.

C. NECA

1.4 ACCEPTABLE MANUFACTURES

A. Provide grounding products manufactured by Copperweld and Cadweld.

1.5 SUBMITTALS

A. Shop drawings shall include, but not limited to the following:

1. Cut sheets of ground rods, clamps and connectors.
2. Grounding system diagram.

PART 2 - PRODUCTS

2.1 GENERAL

A. Provide all materials required to construct a complete grounded electrical system.

B. GROUND RODS: Ground rods shall be 3/4" inch diameter by 10 feet long construction with copper jacket and a steel core.

C. CLAMPS: Ground clamps shall be copper except for steel or iron pipes in which the clamps shall be galvanized iron.

D. CONDUCTORS: Conductors shall be connected by means of an approved pressure connector or clamp.

PART 3 - EXECUTION

3.1 INSTALLATION

A. GENERAL: Install grounding system as shown and specified to ensure a properly grounded system.

B. GROUNDING SEPARATELY DERIVED ALTERNATING CURRENT SYSTEM

C. GROUNDING CONDUCTOR: A grounding conductor and metallic conduit system shall bond all equipment served by the electrical system. Provide a flexible bonding jumper for isolated metallic piping and ductwork and around expansion fittings and joints.

D. CONDUIT GROUNDING BUSHING: Conduit terminating in equipment that has a ground bus such as switchboards, panelboards, etc., shall have grounding bushings installed. Ground each conduit by means of a grounding bushing and to the ground bus in the equipment.

E. LIGHTING FIXTURES: Flexible fixture whips containing a green grounding conductor shall be used to connect light fixtures. Flexible fixture whips shall not exceed ten feet.

3.2 TESTING

A. Perform a ground resistance test using a biddle analog or digital portable earth/ground resistance tester. The system resistance shall not exceed 5 Ohms. Provide additional electrodes as required (refer to 250-84 and 250-56 of the most current edition NEC). Test shall not be conducted following wet weather. Provide personal instruments to conduct these tests and submit certified test for review. Test shall be verified by Engineer.

END OF SECTION 260526

SECTION 260533 - RACEWAYS

PART 1 - GENERAL

1.1 SCOPE

A. Provide electrical raceways and fittings as shown, scheduled, and specified.

B. The types of raceways and fittings required are as follows:

1. Rigid hot-dipped galvanized steel conduit (GRC) (RMC)
2. Intermediate hot-dipped galvanized steel conduit (IMC)
3. Electrical metallic tubing (EMT)
4. PVC (Sch. 40 & 80)
5. Flexible metal conduit (FMC)
6. Liquid-tight flexible metal conduit (LFMC)
7. PVC coated rigid galvanized steel conduit (GRCC)
8. Rigid Aluminum Conduit (RAC)

1.2 REFERENCE STANDARDS

A. ANSI C80.1 - American National Standard for Electrical Rigid Steel Conduit (ERSC); 2020.

B. ANSI C80.3 - American National Standard for Electrical Metallic Tubing -- Steel (EMT-S); 2020.

C. ANSI C80.5 - American National Standard for Electrical Rigid Metal Conduit -- Aluminum (ERMC-A); 2020.

D. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

E. UL 6 - Electrical Rigid Metal Conduit-Steel; Current Edition, Including All Revisions.

F. UL 6A - Electrical Rigid Metal Conduit-Aluminum, Red Brass, and Stainless Steel; Current Edition, Including All Revisions.

G. UL 797 - Electrical Metallic Tubing-Steel; Current Edition, Including All Revisions.

H. NEMA FB-1

I. NEMA TC3

1.3 ACCEPTABLE MANUFACTURERS

A. Raceways

1. Allied
2. Republic
3. Prime Conduit (Carlon)
4. Wheatland Tube
5. Cantex
6. Western Tube
7. Robroy Industries

B. Fittings

1. Appleton
2. Crouse Hinds
3. Steel City
4. O.Z. Gedney
5. Carlon
6. Raco, Inc.
7. Bridgeport

C. Boxes

1. RACO
2. Thomas and Betts
3. EATON
4. Crouse-Hinds
5. Appleton

D. Surface

1. Hubbell
2. Wiremold

1.4 SUBMITTALS

A. Product data shall include but not be limited to:

1. Cutsheets for raceways, fitting, solvents, primers, etc.

1.5 REQUIREMENTS OF REGULATORY AGENCIES WORK IN ACCORDANCE WITH

A. NFPA 70

B. Local, municipal, or state codes that have jurisdiction.

PART 2 - PRODUCTS

2.1 CONDUIT AND FITTINGS

A. Rigid Galvanized Steel Conduit (GRC/RMC)

1. Construction, Materials, Codes, Standards:

a. Article 344 - NFPA 70.
b. Hot-dip galvanized rigid steel conduit, galvanized after fabrication. Products shall comply with UL 6 and ANSI C80.1. All threads shall be galvanized after cutting. A uniform zinc coating shall be applied to the inner and outer walls.
c. Fittings shall be threaded and shipped with thread protectors. Set Screw are not acceptable. Die Cast Fittings are not acceptable.

2. Permitted for use in the following locations:

a. Outdoor or Exterior (Exposed)
b. Indoors, Conditioned Spaces
c. Unconditioned Spaces
d. Underslab (Void Form Slab): where not in contact with earth – only permitted where indicated on plan.
e. Underslab (Suspended Slab): Permitted – only where indicated on plan.

3. Prohibited Locations: Underground, Corrosive environments, Underslab (Slab on Grade), Foundation penetrations.
4. Specific Uses: Exposed Exterior installations, where within or attached to masonry or concrete, where subject to damage.

B. Electrical Metallic Tubing (EMT)

1. Construction, Materials, Codes, Standards:

a. Article 358 - NFPA 70.
b. EMT shall be made of hot-dip galvanized strip steel. The interior shall be coated with a corrosion-resistant lubricant for ease of wiring pulling.
c. Shall utilize steel insulated throat, set-screw connectors, and steel set-screw couplings in all indoor conditioned spaces.
d. Shall utilize steel insulated throat, threadless, watertight compression type connectors, and steel threadless watertight compression type coupling in all non-conditioned spaces and in grout filled CMU walls.
e. Products shall comply with UL 797 and ANSI C80.3.

2. Permitted for use in the following locations:

a. Indoors, Conditioned Spaces
b. Unconditioned Spaces

3. Prohibited Locations: Corrosive Environment, Underground, Underslab (all types), Wet or Damp Locations, Exteriors, Within Concrete, foundation penetrations.
4. Specific Uses: Primary use conduit for indoor spaces, where conditioned. Unconditioned locations shall require use of insulated throat watertight fittings.

C. PVC Coated Rigid Galvanized Steel Conduit (GRCC/Plastibond)

1. Construction, Materials, Codes, Standards:

   a. Article 344 and 300.6 - NFPA 70.
   b. Conduit shall be same as rigid metal conduit with a factory-applied 40-mil-thick covering of polyvinyl chloride (PVC) bonded to the metal, coated inside and outside.

2. Permitted for use in the following locations:

   a. Outdoor or Exterior (Exposed): except for stub-ups and penetrations.
   b. Corrosive Environment: required throughout

      1) Where corrosive environments exist, such as pools, pool pump room, corrosive chemical storage, GRCC shall be provided throughout, up to the point of sealed penetration into a non-corrosive environment.

   c. Underground (Earth, outside foundation perimeter): Required at bends of 15° or greater, Penetrations through concrete, Stub-ups through foundation or grade at concrete.
   d. Foundation Penetrations

3. Prohibited Locations: extended runs exposed to sunlight, Plenums, Underslab except for penetrations (all foundation types).
4. Specific Uses: For use at Cooling Towers, Pools, Pool Decks, Pool pump rooms, chemical storage, corrosive environments.

D. Rigid Aluminum Conduit (RAC)

1. Construction, Materials, Codes, Standards:

   a. Article 344 - NFPA 70.
   b. Rigid aluminum (alloy 6063-T1) conduit shall be manufactured using 6063 Alloy in temper designation T-1.
   c. Fittings for rigid aluminum conduit shall be threaded aluminum shipped with thread protectors. Set Screw or Die Cast Fittings are not acceptable
   d. Products shall comply with UL 6A and ANSI C80.5.

2. Permitted for use in the following locations:

   a. Outdoor or Exterior (Exposed)
   b. Indoors, Conditioned Spaces
   c. Unconditioned Spaces

3. Prohibited Locations: Corrosive environments, underground, within concrete, underslab (all types), foundation penetrations.
4. Specific Uses and Applications: Exposed Exterior such as rooftops or canopies.

PART 3 - EXECUTION

3.1 PROVIDE CONDUIT AS FOLLOWS:

A. GENERAL: The Drawings are diagrammatic and are intended to show the general location of outlets, devices, fixtures, and arrangement and control of circuits. The Contractor shall determine exact locations by actual measurement of the building or by reference to the Architectural Drawings.

B. Raceways shall not be routed below or within slab-on-grade, foundations, or below grade of suspended slab structures, unless specifically noted or indicated otherwise on plan.

C. EMT in sizes up to 4 inches when concealed or not exposed to damage and located indoors only. (EMT is not acceptable in wet and damp location.)

D. MINIMUM SIZE: 3/4 inch.

E. Flexible conduit of any type shall not be used except for connections to rotating or vibrating equipment, or where use for low voltage raceways. All conduit shall be provided as a rigid type conduit for homeruns, runs between termination boxes, outlets, etc.

F. Fixture whips: Refer to 265119 for additional information.

G. Of such size, and so installed that conductors may be drawn in without injury or excessive strain.

H. Where entering panels, pull boxes, junction boxes, or outlet boxes, shall be secured in place with lock nuts inside and outside, and insulated bushings inside.

I. Have Red seal type VCC or approved equal cable supports in risers, as required by NFPA 70.

J. Have ends reamed after cutting and application of die.

K. Keep conduit corked and dry during construction and swab out before conductors are pulled.

L. Have bends and offsets made with approved tools. Bends or offsets in which the pipe is crushed or deformed shall not be installed.

M. Have O.Z. Gedney or approved equal expansion fittings where crossing building expansion joints.

N. Fixtures in finished areas having suspended acoustical ceilings shall be connected to outlet boxes of lighting grid by flexible metal conduit; length not to exceed ten feet (six feet if using 3/8” manufactured fixture “whips”).

O. Outlet boxes in partitions shall never be set back-to-back. They shall be offset to prevent undue noise transmission from room to room.

P. Each entire conduit system shall be installed completely before any conductors are drawn in. Every run of conduit shall be finished before covering up to guard against obstructions and omissions.

Q. Sleeves shall be placed in the forms of concrete, masonry and fire rated walls, floor slabs and beams, for the passage of conduits. Sleeves should be set in place a sufficient time ahead of the concrete work so as not to delay the work. Sleeves shall be rigid galvanized steel with a minimum thickness of 1.07MM and set to extend 4” above slab.

R. All pipe penetrations through walls and concrete floors shall be fire rated by applying USG Thermafiber in the space between the concrete and the pipe. The fire rating shall be additionally sealed by using 3M brand model CP 25 or 303 fire barrier caulk and putty. All fire rating material shall be installed in accordance with manufacturer`s printed instructions.

S. All conduit shall be cleaned and swabbed to remove all foreign matter and moisture prior to pulling wire and cable. All boxes in which conduits terminate shall be cleaned of all concrete mortar and other foreign matter.

T. Provide #30 nylon pulling line in all conduits in which permanent wiring is not installed.

U. All conduit shall be securely fastened and supported using hot galvanized malleable iron one-hole pipe straps, clamps, hanger, or other means approved by the engineer. Supports shall be as required per NEC. Tie wire shall not be used as support or securing means. Support conduit independently of ceiling hanger wire. Use all thread rods to support outlet boxes, junction boxes and conduit.

V. Contact the Architect and Engineer for an installation review before covering any below grade or above grade conduit.

W. All new outlets shall be flush mounted. In remodeled areas where wall construction prohibits flush mounting, provide Hubbell 2400 series, unless noted otherwise. Verify exact location and routing with architect before installation.

X. Contractor shall not penetrate waterproof barriers without using proper fitting to maintain barriers. This shall include exterior walls and slabs. Coordinate with Architect for proper methods.

3.2 Conduit routing

A. Conduit shall be concealed and by using the shortest practicable route between outlets, including where located on CMU walls.

B. Conduit may be exposed in electrical and mechanical rooms, and central plants, or other industrial type facilities such as warehouses or production plants.

C. Install risers, drops, offsets to avoid ductwork and structural components. Ductwork and structural systems shall take precedence to conduit.

D. Any exposed and visible conduit shall be parallel and perpendicular based on the lines of the building (such as ceiling lines, wall blocking lines, or architectural feature lines) using structural systems to conceal conduit visibility at all opportunities.

E. Concealed conduit shall be run in as direct manner as possible, using long bends. All bend radii shall be 12x conduit diameter. Condulets in lieu of elbows where ease of installation and appearance warrant their use – confirmation with architect is required for this use.

F. Conduit shall be continuous, with no more than (4) quarter bends between terminals, cabinets, boxes, or pullboxes is acceptable. Contractor is expected to provide wireway or boxes at appropriate intervals, in accordance with NFPA 70 for wire bending space. All conduit shall be electrically continuous throughout, including across boxes and cabinets. Terminals of all conduit shall be provided with double lock nuts and bushing or terminated on conduit hubs. Use of Running Threads prohibited.

3.3 CONDUIT CORROSION PROTECTION

A. Branch circuit conduits installed in concrete slabs on fill or grade shall be positioned in a manner to ensure complete concrete cover. In no case shall such conduits be exposed below or above the slab surfaces or penetrate the waterproof membrane.

B. At locations where metallic conduits pass through slabs on grade or transitions below grade, PVC coated rigid galvanized conduit shall be used.

C. Conduit installed in the air gap between the water-resistant barrier and finish brick shall not exceed 2-ft. in length.

3.4 EXPANSION JOINTS

A. Install approved expansion fitting in all conduit runs in excess of 150 feet or when crossing building expansion joints.

3.5 OUTLET AND JUNCTION BOXES

A. Provide an approved galvanized outlet box with adequate volume for number of conductors installed.

B. Provide standard galvanized switch boxes of the required number of gangs. Switch boxes where conduit is exposed shall be handy boxes or approved equal.

C. Outlet boxes for receptacles shall be similar to Universal 52151 with suitable raised cover. Receptacle boxes where conduit is exposed shall be handy boxes or approved equal.

D. Weatherproof boxes shall be FS or FD. Provide these boxes in all non-conditioned areas, exterior areas, and natatoriums.

E. Outdoor boxes shall be NEMA 3R, with conduit connections made by Myers Hubs.

F. See notes and details on Drawings for special box requirements.

G. Provide junction boxes required to facilitate installation of the various conduit systems. Provide support boxes required for risers, each complete with approved cable supports as described elsewhere in this Division.

H. Outlet boxes for drywall shall be standard galvanized 4" square boxes with the appropriate device cover. Secure all outlet boxes with a backing brace connected to two adjacent studs. Mounting brackets with a single ear to rest against the backing sheet rock are not acceptable.

I. Provide floor outlet fittings for telephone to match fittings for duplex floor receptacles.

J. Provide 3-1/2” deep gangable masonry boxes in all masonry wall (CMU). Steel City GW-135-G or approved equal.

K. Provide shallow 4”x4” boxes in all demountable partitions.

L. Metallic boxes located in fire rated walls or partitions shall be separated by a minimum horizontal distance of 24 in. This minimum separation distance between metallic boxes may be reduced when “ Wall Opening Protective Materials” (CLIV) are installed according to the requirements of their Classification. Metallic boxes shall not be installed on opposite side of walls or partitions of staggered stud construction unless “Wall Opening Protective Materials” are installed with the metallic boxes in accordance with Classification requirements for the protective materials.

M. Junction, pull boxes, condulets, gutters, disconnects, contactors, etc., above 2-foot x 2-foot grid ceilings shall be mounted within 18-inches of ceiling grid. Above 2-foot x 4-foot grid ceiling they shall be mounted within 30-inches of ceiling grid. All junction box, pull box, gutter openings shall be side or bottom accessible.

N. Junction boxes are prohibited above drywall or plaster ceilings except for lighting; and those must be mounted directly over light fixture opening. Route power, PA, fire alarm conduits to nearest lay-in ceiling.

3.6 THRU-WALL SEALS

A. Provide O.Z. Gedney “Thru-wall” seals for all conduits passing through concrete structure below grade, above grade, and floor penetrations below grade. These prevent moisture from entering the building.

B. Straight sleeves are not acceptable.

3.7 PULL BOXES

A. Interior Pull boxes shall be provided for conduit systems as required and shall be constructed of galvanized steel of not less than gauge and size specified by National Electrical Code. Size pull boxes per Article 314.28 - NFPA 70.

B. Where two or more feeders pass through a common pull box, they shall be tagged to indicate clearly their electrical characteristics, circuit number, and panel designation.

C. Exterior in-ground pull boxes shall have open bottoms with sand and rock beds below box for drainage of water. Provide closed bottom boxes where specified. Closed bottom boxes shall be provided with sumps for portable pump to allow for extracting water. Refer to details on the drawings.

D. Pull boxes mounted in pole bases shall be coordinated with the pour of the pole base and shall be flush with finished footing.

3.8 WIREWAYS

A. Wireways shall be installed as indicated or required and locations shall be coordinated with architect.

B. Wiring in wireways shall be neatly bundled, tied, and suitably tagged.

3.9 UNDERGROUND DUCTBANK SYSTEM

A. DUCT SYSTEM

1. The duct system shall consist of Schedule 40 PVC or type 1-EB PVC conduits encased in red concrete as detailed on the drawings. Use rigid conduit for stub-ups and the last ten feet at the end of each ductbank. Duct lines shall be laid to a minimum grade of 4 inches per 100 feet and shall be free from either horizontal or vertical waves. Duct lines shall be straight unless otherwise noted on the drawings. Duct lines shall be installed so that the top of concrete in encased duct lines is not less than 24 inches below finished grade or finished paving at any point. Changes in direction or runs exceeding a total of 10 degrees, either vertical or horizontal, shall be accomplished by long sweep bends having a minimum radius of curvature of 5 feet. The long sweep bends may be made up of one or more curved or straight sections and/or combinations thereof using five-degree angle couplings. Conduit shall be thoroughly cleaned before using or laying. During construction and after the duct line is completed, the ends of the conduit shall be plugged to prevent water washing mud into the conduits. Particular care shall be taken to keep the conduits clean of concrete, dirt, and any other substance during the course of construction.
2. Each single conduit of the duct bank shall be completely encased in steel reinforced concrete as indicated. The thickness of concrete encasement indicated is the minimum thickness and may be increased to fit the actual shape of trench.
3. Concrete for duct bank envelopes shall be standard 2000 psi concrete mix as described in Division 03 and be colored deep red for permanent marking of underground electrical

work. The concrete red pigment shall be pure inorganic natural metallic base pigment, approved by the Engineer before use. Organic pigments will not be permitted. The approved pigments shall be mixed four pounds per yard of cement.

a. Envelopes may be poured directly against sides of trenches if the "cut" is clean, even, and free of loose material. All loose dirt and extraneous material shall be removed from the trenches before and during the pouring of concrete to ensure sound envelopes. Concrete shall be carefully spaded during pouring to eliminate all voids under and between the conduit and honeycombing of the exterior surfaces. Power driven tampers of agitators shall not be used, unless specifically designed for the application, in order to ensure that the water-tightness of the conduits is not destroyed.
b. Generally, each run of envelopes shall be poured in one continuous operation. Where more than one pour is necessary, each pour shall terminate in a vertical plane. Partial pours shall not terminate in horizontal or angular planes.

B. For normal underground installation see Section 260200, paragraph 3.1 for Excavating and Backfilling.

END OF SECTION 260533

SECTION 260634 - LOW VOLTAGE RACEWAY SYSTEM

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

1.2 WORK INCLUDED

A. Furnish and install a complete raceway system for telephone system, consisting of cabinets, conduit, junction boxes, etc. This shall include but not limited to fire alarm, access control, structured cabling, audio-video, intercommunications, sound reinforcing, intrusion detection, telephone.

1.3 WORK SPECIFIED ELSEWHERE

A. Section 260200 - Basic Materials and Methods for Electrical

B. Section 260533 - Raceways

C. Section 260519 - Wire, Cable and Related Materials

1.4 WORK NOT INCLUDED

A. Cabling

B. Equipment

C. Division 27

D. Division 28

PART 2 - PRODUCTS

2.1 COMPONENTS

A. Conduit - Refer to Section 260533.

B. Backboards - 3/4" X 4' X 8' fire rated plywood painted white.

C. Outlet Boxes - Refer to Section 260533.

D. Pull and junction boxes - Refer to Section 260533.

E. Floor Boxes - Refer to Section 260533.

F. Cabinets - Consult low voltage system installer/supplier.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Refer to Section 260533 for underground service entrance.

B. Provide pull boxes in telephone conduit runs spaced not greater than 100 ft. apart, and on backboard side of runs with more than two right angle bends.

C. Place telephone label on pull and junction boxes.

D. Provide pull wire in each telephone run.

E. Provide plywood backboards and duplex receptacle in the telephone equipment room. Confirm location on jobsite prior to installation.

F. All terminal cabinets/backboards and conduit shall be sized per the recommendations of the telephone system installer.

END OF SECTION 260634

SECTION 260800 - COMMISSIONING OF ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract Documents, including General and Supplementary Conditions and Division 01 Specifications, apply to this section.

1.2 Related sections

A. Section 019100

B. Section 230963

1.3 SUMMARY

A. The commissioning of the lighting system and associated controls shall be performed by an impartial technical firm hired by the owner or shall be performed by the installing contractor if the owner has not hired a commissioning firm. The commissioning provider shall be certified under one or more of the following certifications:

1. CxA - Certified Commissioning Authority - ACG
2. CBCP - Certified Building Commissioning Professional - AEE
3. CCP - Certified Commissioning Professional - BCA
4. CPMP - Certified Process Management Professional - ASHRAE
5. BSC - Building System Commissioning Certification - NEBB

B. The commissioning provider (Commissioning authority) shall be responsible for leading the entire construction team through the commissioning process including, but not limited to, conducting the commissioning kick-off meeting, preparing the commissioning plan, preparing pre-functional checklists, preparing functional test scripts, participation in functional testing and preparation of required documentation and reports.

1.4 RESPONSIBILITIES

A. Contractor: Responsibilities of the Contractor as relate to Commissioning Process include, but are not limited to the following:

1. Facilitate coordination of Commissioning work by Commissioning authority.
2. Attend Commissioning meetings or other meetings called by Commissioning authority to facilitate the Commissioning Process.
3. Review Functional Performance Test procedures for feasibility, safety, and impact on warranty, and provide Commissioning authority with written comment on same.

4. Provide all documentation relating to manufacturer's recommended performance testing of equipment and systems.
5. Provide Operations & Maintenance data to Commissioning authority for preparation of checklists and training manuals.
6. Provide As-built drawings and documentation to facilitate Testing.
7. Assure and facilitate participation and cooperation of Subcontractors and equipment suppliers as required for the Commissioning Process.
8. Certify to Commissioning authority that installation work listed in Pre-Functional Checklists has been completed.
9. Install systems and equipment in strict conformance with project specifications, manufacturer's recommended installation procedures, and Pre-Functional Checklists.
10. Provide data concerning performance, installation, and start-up of systems.
11. Provide copy of manufacturers filled-out start-up forms for equipment and systems.
12. Ensure systems have been started and fully checked for proper operation prior to arranging for Testing with Commissioning authority. Prepare and submit to Commissioning authority **written** certification that each piece of equipment and/or system has been started according to manufacturer's recommended procedure, and that system has been tested for compliance with operational requirements.

    a. Contractor shall carry out manufacturer's recommended start-up and testing procedures, regardless of whether or not they are specifically listed in Pre-Functional Checklists.
    b. Contractor is not relieved of obligation for systems/equipment demonstration where performance testing is required by specifications, but a Functional Performance Test is not specifically designated by Commissioning authority.

13. Coordinate with Commissioning authority to determine mutually acceptable date of Functional Performance Tests.
14. Provide qualified personnel to assist and participate in Commissioning.
15. Provide test instruments and communications devices, as prescribed by Commissioning authority, required for carrying out Testing of systems.
16. Proprietary test equipment required by the manufacturer, whether specified or not, shall be provided by the manufacturer of the equipment. Manufacturer shall provide the test equipment, demonstrate its use, and assist in the commissioning process. Proprietary test equipment shall become the property of the Owner upon completion of commissioning.
17. Ensure deficiencies found in the Commissioning Issues Log are corrected within the time schedule shown in the Commissioning Plan.
18. Provide Commissioning authority with all submittals, start-up instructions manuals, operating parameters, and other pertinent information related to Commissioning Process. This information shall be routed through Architect.
19. Provide commissioning authority with a certificate of readiness to show systems are ready to schedule functional testing.
20. Prepare and submit to Commissioning authority proposed Training Program outline for each system.
21. Coordinate and provide training of Owner's personnel.
22. Prepare Operation & Maintenance Manuals and As-Built drawings in accordance with specifications; submit copy to Commissioning authority in addition to other contractually required submissions. Revise and resubmit manuals in accordance with Design Professionals and Commissioning authority's comments.

23. Commissioning requires participation of this Division Subcontractors to ensure that systems are operating in manner consistent with Contract Documents. All costs associated with the participation of Contractor, Sub-Contractors, Design Professionals, and Equipment Vendors in the Commissioning Process shall be included as part of the Construction Contract.

B. Subcontractors and vendors shall prepare and submit to Commissioning Agent proposed Startup procedures to demonstrate proper installation of systems, according to these specifications and checklists prepared by Commissioning authority.

C. Electrical contractor shall provide a letter certifying the installed lighting controls meet documented performance criteria specified in the commissioning plan within 90 days of substantial completion.

1.5 COMMISSIONING PLAN

A. Commissioning Process tasks and activities:

1. Commissioning kick-off meeting: Conducted by commissioning authority and attended by construction team and design team.
2. Pre-functional checklists: Prepared by the commissioning authority and filled out by subcontractors performing the work that is applicable.
3. Site visits to review installation of applicable systems and progress of checklist documentation performed and reported by commissioning authority.
4. Functional testing: Commissioning authority shall conduct functional testing with assistance of applicable subcontractors and document successful results as well as deficiencies (issues). Functional performance testing shall demonstrate the installation and operation of components, systems, and system-to-system interfacing in accordance with plans and specifications.
5. Preliminary commissioning report: Commissioning authority shall issue a preliminary commissioning report to the owner that has results of the first round of functional testing including deficiencies discovered.
6. Systems manual: Commissioning authority shall compile the systems manual using submittal data provided by the general contractor and applicable subcontractors.
7. Final commissioning report: Commissioning authority shall issue final commissioning report documenting the entire process and final results of functional testing. Report shall include final testing and balancing report.

B. Electrical System Equipment to be tested

1. Occupancy sensors.
2. Time switch controls
3. Daylighting controls.
4. Electrical Service and Distribution System.

C. Testing functions and conditions

1. Daylighting control devices

a. Verify the devices have been calibrated, properly located, and adjusted.
b. Loads adjust to light level set points in response to daylight.
c. Location of calibration equipment is accessible to authorized personnel only.

2. Time switches

a. Verify schedule, time, date, and programming is accurate.
b. Verify override time limit is set, battery is installed, and switch operates the lights that are specified in the design documents.
c. All specified lights can be turned on and off by area control switch.
d. Manual override switch allows only the lights in the space where the switch is located turn on or remain on until next scheduled shut off.

3. Occupant sensors:

a. Certify the sensor has been located and aimed in accordance with manufacturer recommendations.
b. For projects with fewer than seven sensors, each sensor shall be tested.
c. Fore projects with more than seven occupant sensors, testing shall be done for each unique combination of sensor type and space geometry. Where multiples of each combination are provided not less than 10 percent shall be tested.
d. Verify correct operation of status indicators.
e. Controlled lights turn off or down to the permitted level within the required time.
f. For auto-on sensor, the lights turn-on to the permitted level when an occupant enters space.
g. Verify the lights are not incorrectly turned-on by movement in adjacent areas or by HVAC operation.

4. Electrical Service and Distribution System

a. Document the ground resistance testing performed by contractors.
b. Document electrical subcontractor has adjusted breakers to setting recommended by coordination study.
c. Document that any required infrared studies are performed.
d. Document testing of transformer insulation and voltage drop.
e. Document any other testing requirements have been fulfilled as required within specifications.

D. Performance criteria

1. Daylighting controls shall maintain specified light levels within 5% of design.
2. All time switches shall be accurate to time on cellular network devices.

PART 2 - PRODUCTS

NO PRODUCTS SUPPLIED

PART 3 - EXECUTION

1.6 GENERAL

A. This Division has startup responsibilities and are required to complete sub-systems so COMPLETE SYSTEMS are fully functional. Insuring they meet design requirements of Contract Documents. Commissioning procedures and testing do not relieve or lessen this responsibility or shift this responsibility, in whole or in part, to Commissioning Agent or Owner.

B. Coordinate with other Sub-Contractors and equipment vendors to set aside adequate time to address Pre-Functional Checklists, Functional Performance Tests, Operations & Maintenance Manual creation, Owner Training, and associated coordination meetings.

C. Commissioning authority will also conduct site inspections at critical times and issue Cx Field Reports with observations on installation deficiencies so that they may be issued by Architect as deemed appropriate.

1.7 WORK PRIOR TO COMMISSIONING

A. Complete all phases of the work so the systems can be started, adjusted, balanced, and otherwise tested.

B. See pertinent specification sections in this Division, which outline responsibilities for start-up of equipment with obligations to complete systems, including all sub-systems so that they are fully functional.

C. Assist Commissioning Agent with all information pertaining to actual equipment and installation as required complete the full commissioning scope.

D. Contractor shall prepare startup procedures to demonstrate compliance with pre-functional checklists, and coordinate scheduling for completion of these checklists.

E. A minimum of seven (7) days prior to date of system startup, submit to Commissioning Agent for review, detailed description of equipment start-up procedures which contractor proposes to perform to demonstrate conformance of systems to specifications and Checklists.

1.8 PARTICIPATION IN COMMISSIONING

A. Attend meetings related to the Commissioning Process; arrange for attendance by personnel and vendors directly involved in the project, prior to testing of their systems.

B. Provide skilled technicians to startup and test all systems, and place systems in complete and fully functioning service in accordance with Contract Documents.

C. Provide skilled technicians, experienced and familiar with systems being commissioned, to assist Commissioning authority in commissioning process.

1.9 WORK TO RESOLVE DEFICIENCIES

A. Complete corrective work in a timely manner to allow expeditious completion of Commissioning Process. If deadlines pass without resolution of identified problems, Owner reserves the right to obtain supplementary services and/or equipment to resolve the problem. Costs thus incurred will be Contractor's responsibility.

1.10 PRE-FUNCTIONAL CHECKLISTS (PFC)

A. Contractor shall complete Pre-Functional Checklists to validate compliance with Contract Documents installation and start-up requirements, for this Division's systems.

B. Refer to commissioning plan for detailed list of equipment to be commissioned.

1.11 FUNCTIONAL PERFORMANCE TESTING (FPT)

A. Contractor, in cooperation with Commissioning Agent, shall conduct Functional Performance Testing to validate compliance with Contract Documents.

B. Refer to commissioning plan for detailed list of equipment to be commissioned.

C. Provide commissioning authority with a certificate of readiness to show systems are ready to schedule functional testing.

D. Assist Commissioning authority in Functional Testing by removing equipment covers, opening access panels, etc. Furnish ladders, flashlights, meters, gauges, or other inspection equipment, as necessary.

E. Sampling

1. Multiple identical pieces of non-life-safety or otherwise non-critical equipment may be functionally tested using a sampling strategy.
2. Significant application differences and significant sequence of operation differences in otherwise identical equipment invalidates their common identity. A small size or capacity difference, alone, does not constitute a difference. It is noted that no sampling by Subs is allowed in pre-functional checklist execution.
3. A common sampling strategy is the "xx% Sampling - yy% Failure Rule," defined by the following example.

    a. xx = the percent of the group of identical equipment to be included in each sample.
    b. yy = the percent of the sample that if failing, will require another sample to be tested.
    c. The example below describes a 20% Sampling - 10% Failure Rule.
    d. Randomly test at least 20% (xx) of each group of identical equipment. In no case test less than three units in each group. This 20%, or three, constitute the "first sample."
    e. If 10% (yy) of the units in the first sample fail the functional tests, test another 20% of the group (the second sample).

f. If 10% of the units in the second sample fail, test all remaining units in the whole group.
g. If at any point, frequent failures are occurring and testing is becoming more troubleshooting than verification, the CxA may stop the testing and require the responsible Sub to perform and document a checkout of the remaining units, prior to continuing with functionally testing the remaining units.

F. Re-Testing And Failure To Remedy Deficiencies

1. Despite Contractor's best efforts to ensure systems are problem-free, it is expected that some deficiencies will be found during initial inspection of Pre-functional Checklist, and during initial Functional Testing; such deficiencies are expected to be minimal.
2. It is Contractor's responsibility to remedy identified deficiencies, both in Pre-functional Checklist and in Functional Testing phases of work, in a timely and thorough manner.
3. It is Contractor's responsibility to ensure that all deficiencies are corrected prior to requesting a re-inspection or re-test of systems and equipment. Do not request re-inspection or re-test until deficiencies are corrected.

    a. At his discretion, CxA may agree to re-testing systems or equipment where deficiencies remain which are beyond Contractor's control to resolve expeditiously.
    b. Typically, such re-testing of incomplete systems and equipment will take place only if remaining deficiencies are minor in scope and nature, and are of such nature that they cannot be resolved in a timely manner (such as those due to difficulties in obtaining parts, or where Owner has requested a change that has delayed work, etc.)

4. CxA will carry out a second re-inspection or re-test of systems and equipment subsequent to receiving Contractor's request.

    a. If CxA finds deficiencies identified in initial inspection or test have not been remedied (with exception of un-resolvable deficiencies in 3.b. above), and such remaining deficiencies are significant enough to require additional inspection or re-testing, Contractor will be back-charged for CxA's expenses, and time at a rate of $150.00 per hour and $100.00 expenses, for a third and any subsequent re-inspections and re-tests.

G. Deferred Testing

1. "Seasonal Commissioning" pertains to testing during peak heating or cooling seasons when HVAC equipment is operating at full-load or heavy-load conditions. Initial commissioning will be done as soon as contract work is completed, regardless of season. Seasonal Commissioning under full- or heavy-load conditions other than the current season will be handled at later time by GC and CxA.
2. If adequate load may be artificially placed upon heating or cooling equipment, CxA, at his discretion, may perform functional testing during non-peak load periods.
3. GC is to provide services of personnel and participate in seasonal testing process in the same manner as he would in non-seasonal testing.
4. Until off-season commissioning can be accomplished, Owner may retain an amount from GC's payment sufficient to cover the cost of off-season testing.

5. Unforeseen Deferred Tests: If any check or test cannot be completed due to building structure, required occupancy condition, or other reason, execution of checklists and functional testing may be delayed upon approval of Owner. Tests shall be conducted in same manner as seasonal tests, as soon as possible. Services of required parties will be negotiated. Make final adjustments to Operation and Maintenance Manuals and record drawings due to unforeseen deferred tests.
6. GC is to provide services of personnel and participate in deferred testing in the same manner as he would for normal commissioning.

1.12 TRAINING

A. The following requirements are in addition to Operations & Maintenance requirements specified elsewhere in this specification's manual.

B. Contractor shall be responsible for training coordination and scheduling, and ultimately to ensure that training is completed.

C. The training agenda (plan) shall include, at a minimum, the following elements:

1. Purpose of equipment.
2. Principle of how the equipment works.
3. Important parts and assemblies.
4. How the equipment achieves its purpose and necessary operating conditions.
5. Most likely failure modes, causes and corrections.
6. On-site demonstration.

D. Commissioning Agent shall be responsible for overseeing and approving content and adequacy of training of Owner personnel for all installed systems. Provide Commissioning Agent with training plan two weeks before planned training.

1.13 OPERATIONS & MAINTENANCE MANUALS

A. The following requirements are in addition to Operations & Maintenance requirements specified elsewhere in this specification's manual.

B. Contractor shall compile and prepare documentation for equipment and systems specified in this Division and shall deliver documentation to Contractor for inclusion in Operation & Maintenance Manuals, in accordance with requirements of Division 01, prior to training Owner personnel.

C. Provide Commissioning authority with a single, electronic copy of Operation & Maintenance Manuals for review. Commissioning authority's copy of O&M manuals shall be submitted through Architect.

D. Operation and maintenance manuals shall include service agency contact information, maintenance requirements, controls system settings and a narrative of how each system is intended to operate, including set points.

1.14 DOCUMENTATION

A. Commissioning authority shall provide documentation of process as follows:

1. Preliminary commissioning report including test procedures, results of testing, itemization of deficiencies, deferred tests and climatic conditions required for performance of deferred tests. Preliminary commissioning report shall be issued to owner to demonstrate the first pass of testing has occurred and to demonstrate compliance with applicable codes.
2. Final commissioning report shall include the final test and balance report, final results of functional testing, disposition of deficiencies discovered during testing, including the details of corrective measures used and functional testing procedures used for repeatability of testing in the future.

END OF SECTION 260800

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SECTION 260936 - LIGHTING CONTROLS (STAND-ALONE)

PART 1 - GENERAL

1.1 SCOPE

A. Electrical contractor shall provide a complete lighting control system that controls all interior and exterior lighting fixtures, including emergency fixtures. All lighting controls shall be stand-alone and shall not have any communication with adjacent spaces. It is the contractor's responsibility to provide a complete and functional system, including, but not limited to all room controllers, switch packs, power packs, occupancy sensors, low voltage control stations, emergency bypass controllers, low voltage control cable, even if not specifically called out on the plans.

1.2 SUMMARY

A. Section Includes:

1. Digital Occupancy and Daylighting Sensor Control
2. Emergency Lighting Control
3. Control Intent – Control Intent includes, but is not limited to:

    a. Defaults and initial calibration settings for such items as time delay, sensitivity, fade rates, etc.
    b. Initial sensor and switching zones
    c. Initial time switch settings
    d. Emergency Lighting control

1.3 Related Sections

A. Drawings and general provision of the Contact, including General and Supplementary Conditions and Division 01 Specification Sections apply to this Section

B. Section 260200 - Basic Materials and Methods for Electrical

C. Section 260519 - Wire, Cable, and Related Materials: line and low voltage conductors, dimming conductors, securement requirements.

D. Section 262726 - Wiring Devices

E. Section 262926 - Miscellaneous Electrical Controls and Wiring

F. Section 265119 - Lighting Fixtures - Light Emitting Diode (LED)

1.4 REFERENCES

A. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

B. ICC (IECC) - International Energy Conservation Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

D. UL 94 - Tests for Flammability of Plastic Materials for Parts in Devices and Appliances; Current Edition, Including All Revisions.

E. UL 773A - Nonindustrial Photoelectric Switches for Lighting Control; Current Edition, Including All Revisions.

F. UL 924 - Emergency Lighting and Power Equipment; Current Edition, Including All Revisions.

G. UL 1008 - Transfer Switch Equipment; Current Edition, Including All Revisions.

H. UL 1598 - Luminaires; Current Edition, Including All Revisions.

1.5 SYSTEM DESCRIPTION & OPERATION

A. The Lighting Control system as defined under this section covers the following equipment:

1. Room Controllers – Self-configuring and field-configurable, one, two or three relays' controllers, 0–10-volt control for drivers (if applicable).
2. Low Voltage Occupancy/Vacancy Sensors – Self-configuring or field-configurable, Low Voltage, calibrated occupancy sensors, Dual technology or PIR as described by this specification.
3. 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, at a minimum, simple pushbutton interface and allow send/receive of room variables and occupancy/vacancy/photo/daylight sensor settings.
4. 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. Under loss of normal power, the ELCU shall bypass any control device and ensure fixtures are enabled at 100% light output. Comply with UL 924 and UL 1008 as applicable for each instance. Comply with 265119.

B. System shall accommodate the square-footage coverage requirements for each area controlled, utilizing power packs, occupancy and vacancy sensors, switches, daylighting sensors and accessories that suit the required lighting and electrical system parameters.

C. System shall conform to requirements of NFPA 70.

1.6 SUBMITTALS

A. Submittals Package: Submit the shop drawings, and the product data specified below at the same time as a package.

B. Shop Drawings:

1. Composite wiring and/or schematic riser diagram of each control circuit as proposed to be installed (standard diagrams will not be accepted).
2. Scale drawing for each area showing exact location of each sensor, room controller, and digital switch.
3. Riser diagrams to express lighting control hardware and wiring required to meet lighting control sequence of operations.

C. Product Data: Catalog sheets, specifications, and installation instructions.

D. Include data for each device which:

1. Indicates where sensor is proposed to be installed.
2. Prove that the sensor is suitable for the proposed application.

1.7 QUALITY ASSURANCE

A. Manufacturer: Minimum 7 years' experience in manufacture of lighting controls, unless specifically listed in this specification.

B. Lighting controls shall meet the minimum requirements of ICC (IECC) and ASHRAE Std 90.1 I-P as applicable.

1.8 PROJECT CONDITIONS

A. Do not install equipment until following conditions can be maintained in spaces to receive equipment:

1. Ambient temperature: 0° to 40° C (32° to 104° F).
2. Relative humidity: Maximum 90 percent, non-condensing.

1.9 WARRANTY

A. Provide a five-year complete manufacturer's warranty on all products to be free of manufacturers' defects.

1.10 MAINTENANCE

A. Spare Parts:

1. Provide 5spares of each product listed below to be used for maintenance.

a. Room Controllers
b. Power packs
c. Occupancy Sensors
d. Emergency Bypass controllers

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Lutron only

2.2 ALL OCCUPANCY SENSORS (CEILING OR WALL SWITCH)

A. Where specified, vandal resistant wall switch sensors shall utilize a hard lens with a minimum 1.0mm thickness. Products utilizing a soft lens will not be considered.

B. Passive infrared sensors shall utilize Processing protocols to respond only to those signals caused by human motion.

C. Passive infrared sensors shall provide high immunity to false triggering from RFI (hand-held radios) and EMI (electrical noise on the line).

D. Where specified, passive infrared ultrasonic and dual technology sensors shall offer daylighting footcandle adjustment control and be able to accommodate dual level lighting.

E. Dual technology sensors shall consist of passive infrared and ultrasonic technologies for occupancy detection. Products that react to noise or ambient sound shall not be considered.

F. Ultrasonic operating frequency shall be crystal controlled at 25 kHz within ± 0.005% tolerance, 32 kHz within ± 0.002% tolerance, or 40 kHz ± 0.002% tolerance to assure reliable performance and eliminate sensor cross-talk. Sensors using multiple frequencies are not acceptable.

G. All sensors shall be capable of operating normally with electronic ballasts, PL lamp systems and rated motor loads. Coverage of sensors shall remain constant after sensitivity control has been set. No automatic reduction shall occur in coverage due to the cycling of air conditioner or heating fans.

H. In the event of failure, a bypass manual override shall be provided on each sensor. When bypass is utilized, lighting shall remain on constantly or control shall divert to a wall switch until sensor is replaced. This control shall be recessed to prevent tampering.

I. All sensors shall provide an LED as a visual means of indication at all times to verify that motion is being detected during both testing and normal operation.

J. Where specified, sensor shall have an internal additional isolated relay with Normally Open, Normally Closed and Common outputs for use with HVAC control, Data Logging, and other

control options. Sensors utilizing separate components or specially modified units to achieve this function are not acceptable.

K. All sensors shall have UL 94V-0 rated plastic enclosures.

L. Outdoor sensors shall have UL 773A ratings. EWF outdoor sensors shall additionally have UL 1598 ratings.

M. Outdoor sensors shall have an operating temperature range of -40°F to +130°F

N. To ensure complete protection from weather elements and exposure, outdoor sensors shall be rated and listed for outdoor use.

O. Multiple occupancy sensors may be installed in a room by simply connecting them to the free topology room system. No additional configuration will be required.

P. All devices shall be hard wired. No wireless devices shall be permitted.

2.3 WALL OR CEILING MOUNTED OCCUPANCY SENSOR SYSTEM

A. Ceiling mounted (to suit installation) passive infrared (PIR), ultrasonic or dual technology digital (passive infrared and ultrasonic) occupancy sensor. provide the Company's system which accommodates the square-foot coverage requirements for each area controlled, utilizing room controllers, occupancy sensors and accessories which suit the lighting and electrical system parameters. Passive infrared only sensors shall not be used for classroom applications.

B. Occupancy Sensors shall provide Features include the following: digital or analog calibration and pushbutton/dip-switch/dial programming for the following variables:

1. Sensitivity – 0-100% in 10% increments
2. Time delay – 1-30 minutes in 1-minute increments
3. Test mode – Five second time delay
4. Detection technology – PIR, Ultrasonic or Dual Technology activation and/or re-activation.
5. Walk-through mode
6. Load parameters including Auto/Manual-ON, and daylight enable/disable when photosensors

C. Device Status LEDs including:

1. PIR Detection
2. Ultrasonic detection
3. Configuration mode
4. Load binding

D. Manual override of controlled loads.

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 may contain dip switches, potentiometers, or other easily adjustable field devices to allow for easy modification. All 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. Quick installation features including:

    a. Standard junction box mounting
    b. Quick low voltage connections using standard RJ-45 patch cable

4. Plenum rated
5. Manual override and LED indication for each load
6. Dual voltage (120/277 VAC, 60 Hz)
7. Zero cross circuitry for each load.

B. On/Off/Dimming enhanced Room Controllers shall include:

1. Real time current monitoring
2. One, two or three relay configuration
3. Efficient 250 mA switching power supply
4. RJ-45 local ports or other manufacturer provided wiring connection methods for connection to other devices on the same system.
5. One 0–10-volt analog output per relay for control of compatible ballasts and 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
    c. Set lamp burn in time for each load up to 100 hours

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

2.5 EMERGENCY LIGHTING

A. Emergency Lighting Control Unit - A UL 924 listed device that monitors a switched circuit providing normal lighting to an area. The unit provides normal ON/OFF control of emergency lighting along with the normal lighting. Upon normal power failure the emergency lighting

circuit will close, forcing the emergency lighting ON until normal power is restored. Features include:

1. 120/277 volts, 50/60 Hz., 20-amp ballast rating
2. Push to test button
3. Auxiliary contact for remote test.

B. Include fire alarm interface with all UL 924 and UL 1008 devices.

2.6 Power Packs

A. Control Units - For ease of mounting, installation and future service, control unit(s) shall be able to externally mount through a 1/2" knock-out on a standard electrical enclosure and be an integrated, self-contained unit consisting internally of an isolated load switching control relay and a transformer to provide low-voltage power. Control unit shall provide power to a minimum of five (5) sensors.

B. Relay Contacts shall have ratings of 20A, 16A continuous, LED Lighting loads, switched receptacle and associated common motor loads that can be fed by common 5-20R receptacles.

C. Control wiring between sensors and controls units shall be Class II, 18-24 AWG, stranded U.L. Classified, PVC insulated or TEFLON jacketed cable suitable for use in plenums, where applicable.

PART 3 - EXECUTION

3.1 PREPARATION

A. Do not begin installation until measurements have been verified and work areas have been properly prepared.

B. If preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

C. Verify that required pre-installation meeting specified in Part 1 of this specification has been completed, recorded meeting minutes have been distributed and all outstanding issues noted have been resolved prior to the start of installation.

3.2 INSTALLATION

A. Contractor must arrange virtual or phone meeting with the manufacturer before project rough-in to ensure the hardware, cabling, and overall system requirements are understood and met.

B. All line voltage connections shall be tagged to indicate circuit and switched legs.

C. Test all devices to ensure proper communication.

D. Electrical contractor shall calibrate all sensor time delays and sensitivity to guarantee proper detection of occupants and energy savings. Adjust time delay so that controlled area remains lighted while occupied.

E. Tighten all panel Class I conductors from both circuit breaker and to loads to torque ratings as marked on enclosure UL label.

F. All Class II cabling shall enter enclosures from within low-voltage wiring areas and shall remain within those areas. No Class I conductors shall enter a low-voltage area.

G. Contractor shall provide to the manufacturer all quantities for system including but not limited to relays, room controllers, relay panels, plug load controllers, switches, sensors and wire lengths and configurations for device cable at least 1 week before bid.

H. Install all devices as required by manufacturer submitted shop drawings and installation guidelines. Wiring details included with the construction documents are for general scope of work, and exact wiring and connections may vary by manufacturer.

I. The contractor shall coordinate rough-in size and quantity with the number of devices necessary. Since many control devices may accommodate multiple switch legs in a single gang, there may be an indirect relationship between number of devices and number of control zones.

J. Provide J-hooks for supporting all low-voltage cabling at a spacing not to exceed 5 ft. between hooks.

K. The lighting control system must function within the guidelines stated in the lighting control sequence of operation notes, details, matrices, and narratives on the plans.

3.3 COMMISSIONING

A. Upon completion of the installation, the system shall be commissioned by a commissioning agent representative who will verify a complete fully functional system is installed as required by plans and specifications.

B. Provide a training session for the owner’s operations personnel. Training session shall be performed by a qualified person who is knowledgeable in the subject/equipment. Submit a training agenda two (2) weeks prior to the proposed training session for review and approval. Training session shall include at the minimum:

1. Purpose of equipment.
2. Principle of how the equipment works.
3. Important parts and assemblies.
4. How the equipment achieves its purpose and necessary operating conditions.
5. Most likely failure modes, causes and corrections.
6. On-site demonstration.

END OF SECTION 260936

SECTION 262213 - LOW VOLTAGE DISTRIBUTIONS TRANSFORMERS

PART 1 - GENERAL

1.1 SCOPE

A. Provide 480-volt primary step-down transformers as shown, scheduled, and as specified.

B. The type of transformers required includes dry-type general purpose transformers.

1.2 STANDARDS

A. Products shall be designed, manufactured, tested, and installed in compliance with applicable ANSI/IEEE and NEMA standards.

B. All low voltage transformers shall be UL listed and labeled.

C. All low voltage transformers 15 kVA and larger shall meet or exceed post-January 1, 2016, U.S. DOE efficiency requirements Energy, 10 C.F.R. §431.196(a)(2) (2015) regardless of whether transformer date of manufacture is pre or post January 1, 2016.

D. All low voltage transformers 15 kVA and larger shall be tested for efficiency in accordance with U.S. DOE test methods Energy, 10 C.F.R. §431, Subpart K, Appendix A (2015).

1.3 ACCEPTABLE MANUFACTURERS

A. Provide one of the following manufacturers for general purpose use:

1. PowerSmiths
2. PoweSmiths E-Saver OPAL
3. Power Quality International
4. Power Quality International EYe-Rates Series
5. Mirus
6. Mirus ULLTRA

1.4 SUBMITTALS

A. Shop drawings shall include, but not be limited to:

1. Cutsheets of transformers with sound and load ratings, dimensions, weights, impedance rating, insulation type, temperature rise and tap configurations.

1.5 REQUIREMENTS OF REGULATORY AGENCIES

A. National Electrical Code.

B. Local, municipal, and/or state codes that have jurisdiction.

PART 2 - PRODUCTS

2.1 GENERAL PURPOSE

A. Provide dry type, two-winding transformers with primary and secondary voltages and KVA ratings as shown on plans. Transformers shall operate at 60 hertz. All transformers shall be manufacture with standard materials and components.

2.2 MATERIALS AND COMPONENTS FOR GENERAL PURPOSE TRANSFORMERS

A. All cores shall be constructed of high grade, non-aging silicon steel with high magnetic permeability, and low hysteresis and eddy current losses. Magnetic flux densities are to be kept well below the saturation point. The core laminations shall be clamped together with structural steel angles. The completed core and coil shall be isolated from the base by means of rubber, vibration-absorbing mounts. There shall be no metal-to-metal contact between the core and coil and the enclosure. The vibration isolating system shall be designed to provide a permanent fastening of the core and coil to the enclosure. Sound isolating system requiring the complete removal of all fastening devices will not be accepted. Windings shall be copper or electrical grade aluminum terminated on tin plated or copper bars. Foil windings are not acceptable.

B. The transformer core shall be visibly grounded to the enclosure by means of a flexible grounding conductor sized in accordance with NEMA, IEEE and ANSI standards.

C. Transformer coils shall be of continuous-wound type construction and shall be impregnated with non-hygroscopic, thermo-setting varnish.

D. Transformers shall be enclosed in drip-proof, metallic enclosures designed to provide for air cooling and prevent accidental contact with live conductors. Wiring compartment shall be located below the core and coil and cooled by air circulation or insulated from the core and coil by means of a suitable thermal insulation barrier. Transformer exposed to weather or installed in a sprinkled area shall have rain shields on all openings. Entire transformer enclosure shall be cleaned, phosphatized, primed and painted with a gray, baked enamel.

E. Transformers shall operate at 100% nameplate KVA rating continuously while in a 40 degree C ambient without exceeding the rated average winding temperature rise of the ANSI insulation system as described below.

F. Temperature rating shall be as follows:

RATING	PHASE INSULATION-TEMP. RISE
0.025 through 3 KVA	SingleType B - 80º C
5 through 25 KVA	SingleType F - 115º C

3 through 15 KVA	ThreeType F - 115º C
37½ KVA and larger	SingleType H - 150º C
30 KVA and larger	ThreeType H - 150º C

G. Transformers shall have minimum full load rated taps in the primary windings as follows:

RATING	TAPS
3 through 25 KVA	2 - 5% FCBN
15 through 300 KVA	6 - 2-½% TAPS, 2 above and 4 below nominal

H. Maximum sound ratings shall be as follows:

KVA	dBA
0 to 9	40
10 to 50	45
51 to 150	50
151 to 300	55
301 to 500	60

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install transformer in accordance with manufacturer`s written instructions, and recognized industry practices.

B. Housekeeping Pad: Provide a nominal 3-½" high, 2500 PSI (28 Day) concrete reinforced pad with number 6 welded wire mesh. The pad shall conform to the shape of the transformer and extend at least 3 inches beyond the length and width of the transformer. All corners of the pad shall be rounded.

C. Mounting: Install floor mounted transformers on properly sized rubber-in-shear vibration isolators. Trapeze mounted transformers shall use rubber-in-shear hangers. Wall mounted transformers shall not be mounted directly to the wall without vibration isolation.

D. Connection: Route conductors in a minimum of 2 feet of flexible steel conduit to transformer enclosure. Provide grounding conductor sized per NEC, connected to the building grounding electrode system.

3.2 TESTING

A. Insulation, Tests: Prior to energization, check transformers windings for continuity and test the insulation resistance. Tests shall be made using a Biddle Megger or equivalent test instrument, per manufacturers' recommendations. Provide written documentation of testing. Submit with O & M manuals.

B. Tap Setting: Measure current and voltage under load conditions to provide correct tap settings.

END OF SECTION 262213

SECTION 262416 - PANELBOARDS

PART 1 - GENERAL

1.1 SCOPE

A. Provide panelboards as shown, scheduled, and as specified herein.

B. The types of panelboards include:

1. Panelboards.
2. Power distribution panelboards.
3. Load centers

1.2 REFERENCE STANDARDS

A. ANSI C12.1 - Electric Meters - Code for Electricity Metering; 2024.

B. ANSI C12.20 - American National Standard for Electricity Meters - 0.1, 0.2, and 0.5 Accuracy Classes; 2022.

C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

D. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.

E. UL 67 - Panelboards; Current Edition, Including All Revisions.

F. UL 943 - Ground fault Circuit Interrupters

G. NEMA PB 1 - Panelboards

H. NEMA PB 1.1 - General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less

I. NEMA, ABI, Molded Car Circuit Breakers, and Molded Case Switches

J. Federal Spec W-P 115, Rev C, Panel, Power Distribution

K. NEMA KSI, Enclosed and Miscellaneous Distribution Equipment Switches (600V)

1.3 ACCEPTABLE MANUFACTURERS

A. Provide one of the following manufacturers:

1. General Electric Company/ABB
2. Square D Company
3. Siemens
4. Cutler Hammer

1.4 SUBMITTALS

A. Shop drawings shall include, but not be limited to:

1. Cutsheets of all enclosures, circuit breakers, fusible switches, bussing, rating, schedules, and all accessories clearly labeled.

1.5 REQUIREMENTS OF REGULATORY AGENCIES

A. WORK IN ACCORDANCE WITH:

1. NFPA 70
2. Local, municipal, or state codes that have jurisdiction.

PART 2 - PRODUCTS

2.1 MATERIALS AND COMPONENTS

A. General

1. Provide power distribution and panelboards as indicated in the panelboard schedule and as shown on the plans. Load centers are acceptable for use in dwelling units. Power distribution panelboards shall be equipped with fusible switches or circuit breakers as shown on the schedule. Panelboards shall be equipped with thermal-magnetic, molded case circuit breakers of frame and trip ratings as shown on the schedule.

B. Busing Assembly and Temperature Rise

1. Panelboard bus structure and main lugs or main breaker shall have current ratings as shown on the panelboard schedule. Such ratings shall be established by heat rise tests with maximum hot spot temperature on any connector or bus bar not to exceed 65°C. rise above 40°C ambient. Heat rise test shall be conducted in accordance with Underwriters Laboratories Standard UL 67. The use of conductor dimensions will not be accepted in lieu of actual heat tests. All current carrying parts of the bus shall be tin- or silver-plated copper.
2. Bus structure shall be isolated. Bus bar connections to the branch circuit breakers shall be distributed phase or phase sequence type and shall accept bolt-on circuit breakers for lighting and appliance panelboards.
3. The lugs for terminating conductors shall be rated at 75°C on all panel boards and circuit breakers.

4. Provide a non-insulated bare copper ground bus. Provide an isolated ground copper bus in each panel serving isolated ground circuits as indicated on panel schedule or one-line diagram. Provide a full-size copper neutral bus in each panelboard enclosure. Provide a 200% neutral buss when served by a harmonic mitigating transformer and any K4 or higher rated transformers.

C. Distribution Panelboards

1. Provide arc energy reduction switch for each overcurrent device rated 1,200 amps or larger to comply with 240.87 of the NEC. Switch shall be equipped with a pad lockable cover with a blue LED pilot light that illuminates when system is activated. Locate switch and cover recessed mounted adjacent to the switch it serves or remote as indicated on the plans. Provide label and all required hardware. Remote switch(es) shall be flush mounted in wall near entry to the room.
2. Circuit breakers shall be equipped with individually insulated, braced, and protected connectors. The front faces of all circuit breakers shall be flush with each other. Large, permanent, individual circuit numbers shall be affixed to each breaker in a uniform position. Tripped indication shall be clearly shown by the breaker handle taking a position between “ON” and “OFF.” Provisions for additional breakers shall be such that no additional connectors will be required to add breakers. Circuit breakers shall be of the frame size, trip setting and interrupting capacity as indicated on the drawings. Circuit breakers shall be rated 65,000 AIC unless otherwise noted on plans.
3. All fusible switches shall be quick-make, quick-break with visible blades and dual horsepower ratings. Switch handles shall physically indicate “ON” and “OFF” positions. Switches shall be lockable only in the “OFF” position and accept three industrial type heavy duty padlocks. Switch covers and handles shall be interlocked to prevent opening in the “ON” position. A means shall be provided to permit authorized personnel to release the interlock for inspection purposes. Switches shall include positive pressure rejection type fuse clips for use with UL Class R fuses or Class J fuses and be UL labeled for 200,000 AIC.

D. 480/277 Volt Panelboards

1. Main breakers shall be vertically mounted. Branch mounted main breakers are not acceptable. Provide electronic trip mains with long term, short term and instantaneous trips as indicated on drawings and required for selective coordination.
2. Circuit breakers shall be bolt-on thermal-magnetic, molded case circuit breakers. Breakers shall be 1, 2 or 3 pole with an integral crossbar to assure simultaneous opening of all poles in multiple circuit breakers. Breaker shall have an over-center, trip-free, toggle-type operating mechanism with quick-make, quick-break action and positive handle indication. Handles shall have “ON,” “OFF” and “TRIPPED” positions. Circuit breakers shall be UL listed in accordance with UL Standard 489 and shall be rated 277-volt ac (single pole, 15-30 amperes) or 480Y/277 volts ac (2 and 3 pole) with continuous current ratings as noted on the plan. Interrupting ratings shall be a minimum of 18,000 rms symmetrical amperes at 277 volts ac (single pole) or 480Y/277 volts ac (2 and 3 pole) unless otherwise noted on plans.

E. Cabinets and Fronts

1. The panelboard bus assembly shall be enclosed in a steel cabinet. The rigidity and gauge of steel to be as specified in UL 50 for cabinets. Wiring gutter space shall be in accordance with UL 67 for panelboards. The box shall be fabricated from galvanized steel or equivalent rust resistant steel. Provide stainless steel front cover for all panels located in all Pool Equipment rooms, Food Labs, Snack Bars, Culinary Arts, Kitchens, and Life Skills rooms. All NEMA-1 panels shall have hinged front covers. The front cover shall have a door with hinges, latch, and a lock. The piano hinged front covers door-in-door shall allow full access to the circuit breaker gutter area without having to remove the entire front cover. All panelboard lock shall be keyed alike. Circuit breaker and fusible distribution panels shall have four-piece trims. A welded circuit directory frame and card with a clear plastic covering shall be provided on the inside of the door. Provide NEMA 1 enclosure where installed indoors unless otherwise noted. Provide NEMA 3R enclosure where installed outside or in a sprinkled area.

F. Safety Barrier

1. The distribution panelboard interior assembly shall be dead front with panelboard cover removed. Main lugs or main breakers shall have a barrier. The barrier in front of the main lugs shall be hinged to a fixed part of the interior. The end of the bus structure opposite the mains shall have barriers.

G. Integrated Equipment Short Circuit Rating

1. Each panelboard, as a complete unit, shall have a short circuit current rating equal to or greater than the integrated equipment rating shown on the panelboard schedule or on the plans. This rating shall be established by testing with the over-current devices mounted in the panelboard. The short circuit tests on the over-current devices and on the panelboard, structure shall be made simultaneously by connecting the fault to each over-current device with the panelboard connected to its rated voltage source. Method of testing shall be per UL 67. The source shall be capable of supplying the specified panelboard short circuit current or greater. Testing of panelboard over-current devices for short circuit rating only while individually mounted is not acceptable. Also, testing of the bus structure alone is not acceptable. Panelboards shall be marked with their maximum short circuit current rating at the supply voltage and shall be UL listed.

H. Metering

1. Provide a branch circuit meter to meter the branch circuits indicated on the drawings. It shall provide kW, kVA, kWh and kVAh. It shall be mounted in the panelboard or externally mounted next to the panel. Communication protocol shall include BACnet and Modbus TCP over ethernet. Connect to the Building Automation System. Program to notify building owner if the load exceeds values set by the energy code indicated on the load analysis. This shall comply with 220.12 Exception No. 1 of the 2020 NEC.
2. Provide a panelboard meter to meter the entire panel as indicated on the drawings. It shall include per phase and total kW, kVA, accumulated kWh, kVAh, power factor, peak demand, frequency, current and voltage. It shall be mounted in the panel board or externally mounted next to the panelboard. Communication protocol shall include BACnet and Modbus TCP over ethernet. Connect to the Building Automation System. Program to notify building owner if the load exceeds values set by the energy code indicated on the load analysis. This shall comply with 220.12 Exception No. 1 of the

adopted version of the NEC. Connect the meter to the building automation system before entergizing.1

3. Meters shall be provided with an accuracy of 1.0% and shall be certified to ANSI C12.1 or ANSI C12.20 as applicable.

I. Load Centers

1. Provide load centers where indicated.
2. Load centers shall have mains ratings and branch circuit breaker ratings of the size and number as indicated on drawings. Load centers shall be plug-on type construction. All current carrying parts of the bus assembly shall be plated copper. Terminals for feeder conductors to mains and branch neutral shall be UL listed as suitable for the type conductor specified. The load center bus assembly shall be enclosed in steel cabinet. The size of the wiring gutters and gauge steel shall be in accordance with UL 50 and UL 67. Fronts shall include door and be provided with a directory for circuit identification. Load center boxes and fronts shall have corrosion resisting phosphate treatment and a gray baked enamel finish. Load centers shall be UL listed and meet Federal Specification W-P-115B as Type I, Class 2.
3. All breakers shall be full width, plug-on-type, toggle action with quick-make, quick-break mechanism. Provide Square D ‘QO,’ GE 'THQL' breakers or approved equal. Piggy-back or half width breakers are not acceptable. Trip indication shall be clearly shown by the breaker handle taking a position between “ON” and “OFF” when the breaker is tripped. All multi-pole breakers shall have single operating handle, common trip variety. Branch circuit breakers feeding convenience outlets shall have sensitive, instantaneous trip in order to give “flash protection” for frayed, stranded wire cords. QWIK-GARD circuit breakers with ground fault circuit interrupters shall be used in accordance with the National Electrical Code. Circuit breakers shall be UL listed and meet the requirements of Federal Specification W-C-375B/GEN, Class 1. Provide ARC Fault circuit interrupter breaker to comply with 210.12 of the NEC.
4. Provide Surge Protection Device with a minimum of 100 kA.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install panelboards, including electrical connections, in accordance with manufacturers written instructions, NFPA 70 and recognized industry practices.

B. All panels shall be mounted to unistrut. Unistrut shall be securely mounted to the floor and structural ceiling. Toggle bolts or anchor bolts attached to drywall is not acceptable.

C. Housekeeping Pads: Mount floor mounted panelboards on 4-inch-high concrete housekeeping pads.

D. Fuses: Install fuses of the rating and class as shown in each fusible distribution panel scheduled on drawings.

E. Conduits: Stub up three one-inch conduits to an accessible location above the ceiling for each recessed panelboard.

3.2 IDENTIFICATION

A. Nameplate: Each panelboard shall have an engraved bakelite nameplate. Nameplates shall be white with black letters and show panel designation. Nameplates shall be attached with stainless steel screws. Refer to Section 260200, paragraph 2.8(C).

B. Directory Card: 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 location and name of each item of equipment served. Spares and spaces shall be written in erasable pencil for future use. Circuit directory shall show the room served by each circuit. The final graphs/signage room numbers shall be used. Do not use Architectural numbering on plans.

C. Replacement Components: Where circuit breakers or fuses are applied in compliance with the series combination ratings marked on the equipment by the manufacturers, the equipment enclosure(s) shall be legibly marked in the field to indicate the equipment has been applied with a series combination rating. The marking shall be readily visible and state "caution - Series Rated System." (NEC 110-22). Nameplate shall also identify replacement components.

D. Replacement Components: Nameplate shall identify replacement components.

3.3 INFRARED SCANNING

A. After Substantial Completion by not more than 2 months after Final Acceptance, perform an infrared scan of each panelboard. Remove fronts if not equipped with viewing ports to make joints and connections accessible to a portable scanner. Submit a copy the owner and engineer for review. If O&M manuals are submitted prior to performance of infrared scan, contractor shall submit a signed letter to verify the scan has been arranged. Letter shall indicate the scan provider and the date It will be performed.

END OF SECTION 262416

SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.1 SCOPE

A. Provide wiring devices as shown, scheduled, required, and as specified.

B. The types of wiring devices required include:

1. Switches
2. Receptacles
3. Occupancy Sensors
4. Digital Timer Switches
5. Coverplates
6. Floor Boxes
7. Fire Rated Poke Through Devices

1.2 REFERENCE STANDARDS

A. FS W-C-596 - Connector, Electrical, Power, General Specification for; 2014h (Validated 2022).

B. FS W-S-896 - Switches, Toggle (Toggle and Lock), Flush Mounted (General Specification); 2017g (Validated 2023).

C. NEMA WD 1 - General Color Requirements for Wiring Devices; 1999 (Reaffirmed 2020).

D. NEMA WD 6 - Wiring Devices - Dimensional Specifications; 2021.

E. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

F. UL 20 - General-Use Snap Switches; Current Edition, Including All Revisions.

G. UL 498 - Attachment Plugs and Receptacles; Current Edition, Including All Revisions.

H. UL 943 - Ground-Fault Circuit-Interrupters; Current Edition, Including All Revisions.

I. UL 1310 - Class 2 Power Units; Current Edition, Including All Revisions.

J. UL 1699 - Arc-Fault Circuit-Interrupters; Current Edition, Including All Revisions.

1.3 QuALITY ASSURANCE

A. All wiring devices shall comply with NEMA WD 1 and NEMA WD 6 as well as FS W-C-596 and FS W-S-896 as applicable.

B. All switches shall comply with UL 20 as applicable.

C. All receptacles shall comply with UL 498 as applicable.

D. All GFCI receptacles shall comply with UL 943.

E. All USB charging receptacles shall comply with UL 1310.

F. All AFCI receptacles shall comply with UL 1699.

1.4 ACCEPTABLE MANUFACTURERS

A. Hubbell

B. Leviton

C. Pass & Seymour

1.5 SUBMITTALS

A. Shop drawings shall include but not be limited to:

1. Cut sheets of all devices indicating NEMA configuration, rating, materials, color, and all accessories.
2. Cut sheets of all coverplates indicating materials, color and any engraving specified on drawing or in the specifications.

1.6 REQUIREMENTS OF REGULATORY AGENCIES WORK IN ACCORDANCE WITH

A. National Electric Code.

B. Local, municipal, or state codes that have jurisdiction.

PART 2 - PRODUCTS

2.1 MATERIALS AND COMPONENTS

A. GENERAL

1. Provide factory assemble wiring devices with the rating type and color as required and specified for the service indicated.
2. Provide matching one-piece multiple gang plates where switches are ganged.
3. Provide wall plates for each receptacle furnished.
4. Architect reserves the right to select wiring device styles and colors to match wall finish.
5. Wall plates shall be of same manufacturer as devices.

2.2 SWITCHES

A. Provide specification grade White toggle switches where indicated on the Drawings. Provide "Red" switches for switching emergency lighting circuits where switching is indicated. Coordinate exact locations with architect.

1. Wall switches shall be 20-amp, 120-277 volt and shall be Hubbell, Leviton, or P&S as follows:

TOGGLE SWITCHES	**HUBBELL**	**LEVITON**	**P&S**
SINGLE POLE	HBL1221	1221-2	PS20AC1
DOUBLE POLE	HBL1222	1222-2	PS20AC2
THREE WAY	HBL1223	1223-2	PS20AC3
FOUR WAY	HBL1224	1224-2	PS20AC4
MOMENTARY CONTACT	HBL1557	1257	1251
THREE POSITION, TWO CIRCUIT MAINTAINED CONTACT	HBL1385	1285	1225
KEY TYPE LOCKABLE BARREL KEY OR CORBIN STYLE	HBL1221-RKL	1221-2KL	PS20AC1-KL
PROVIDE WITH EXTRA KEYS	HBL1209RKL	2KL	4609
DISCONNECT SWITCH / INSTA HOT	HBL7810DS	MS303-DSS	7803

2. Dwelling units shall use Hubbell CS115I, CS120I, P&S CS15AC1, and CS20AC1.
3. Dimmers: Provide Lutron DIVA or equal as shown on drawings. Wall box dimmers shall be sized to handle the load served. Provide phase dimmers to control LED lamps when 0-10 volt dimming drivers are not provided.
4. Light Handle Switches: Provide Hubbell HBL1221-IL, Leviton 1221-LHC, P&S PS20AC1-ISl lighted handles to switch emergency lights where noted on the drawings.

B. Provide specification grade White decora style rocker switches where indicated on the Drawings. Provide "Red" switches for switching emergency lighting circuits where switching is indicated. Coordinate exact locations with architect.

1. Wall switches shall be 20-amp, 120-277 volt and shall be Hubbell Decorator Series, Leviton, Decora or Pass & Seymor Decorator, as follows:

ROCKER/DECORATOR SWITCHES	**HUBBELL**	**LEVITON**	**P&S**
SINGLE POLE	DS120	5621-2	2621
DOUBLE POLE	DS220	5622-2	2622
THREE WAY	DS320	5623-2	2623
FOUR WAY	DS420	5624-2	2624
MOMENTARY CONTACT	HBL1557	1257	1251
THREE POSITION, TWO CIRCUIT MAINTAINED CONTACT	HBL1385	1285	1225
KEY TYPE LOCKABLE BARREL KEY OR CORBIN STYLE	HBL1221-RKL	1221-2KL	PS20AC1-KL
PROVIDE WITH EXTRA KEYS	HBL1209RKL	2KL	4609
DISCONNECT SWITCH / INSTA HOT	HBL7810DS	MS303-DSS	7803

2. Dimmers: Provide Lutron DIVA or equal where required. Wall Box dimmers shall be sized to handle the load. Provide Phase dimmers to control LED lamps when 0-10V drivers are not provided.
3. Light Handle Switches: Provide Leviton 5649-2 or P&S 2625 lighted handles to switch emergency lights where noted on the drawings.

2.3 RECEPTACLES

A. Provide specification grade White receptacles where indicated on the drawings. Provide “Red” receptacles for receptacles on emergency power. Coordinate exact location with architect.

1. Receptacles shall be Hubbell, Leviton or Pass & Seymour as follows:

CONVENTIONAL RECEPTACLES	**HUBBELL**	**LEVITON**	**P&S**
HEAVY DUTY BRASS MOUNTING YOKE NEMA 5-20R DUPLEX	HBL5352	5362	5362
HEAVY DUTY BRASS MOUNTING YOKE NEMA 5-20R SIMPLEX	HBL5361	5361	5361
ISOLATED GROUND 20A, 125V ORANGE NEMA 5-20R DUPLEX	IG5352	5362IG	IG5362
CLOCK HANGER 15A-125V BROWN WITH STAINLESS STEEL PLATE WITH HANGER	HBL5235	5361-CH	S3733-SS
GFCI DUPLEX 20A, 125V SELF TESTING, FEED THRU CAPABLE, TAMPER RESISTANT FOR LOCATIONS REQUIRING TAMPER RESISTANT INSTALLATION OR AS INDICATED ON THE DRAWINGS	GFRST20	GFTR2	2097TR
GFCI DUPLEX 20A, 125V SELF TESTING, FEED THRU CAPABLE, TAMPER/WEATHER RESISTANT FOR INSTALLATION IN DAMP/WET LOCATION OR AS INDICATED ON THE DRAWINGS	GFTWRST20	GFWR2	2097TRWR
HEAVY DUTY TAMPER RESISTANT BRASS MOUNTING YOKE	HBL5362WTR	5362-SG	---
TAMPER RESISTANT 20A, 125V DUPLEX	BR20WHITR	8300-SG	TR63-H
SURGE PROTECTION 20A, 125V DUPLEX, BLUE NEMA 5-20R WITH AUDIBLE ALARM	HBL5362SA	7380-B	5362SP
USB CHARGER TYPE DUPLEX 20A, 125V TAMPER RESISTANT, DUAL USB TYPE A PORTS MIN. OF 5A USB OUTPUT, TAMPER RESISTANT	USB20A5x 5A OUTPUT	T5832* 3.6A OUTPUT	2097TRUSBA4* 2.1A OUTPUT
PLUG LOAD CONTROLLED RECEPTACLES 20A, 125V TAMPER RESISTANT WITH TWO CONTROLLED FACES	BR20C2WHITR	TBR20-S2W	TR5362CDW

PLUG LOAD CONTROLLED RECEPTACLES 20A, 125V TAMPER RESISTANT WITH ONE CONTROLLED FACE	BR20C1WHITR	TBR20-S1W	TR5362CHW
ARC FAULT CIRCUIT INTERRUPTER RECEPTACLES	AF20TRW	AFTR2-W	AF202TRW
GROUND FAULT CIRCUIT INTERRUPTER / ARC FAULT DUAL FUNCTION	AFGF20TR	AGTR2-W	AFGF202TR

B. Provide specification grade, Decora type White receptacles where indicated on the drawings. Provide “Red” receptacles for receptacles on emergency power. Coordinate exact location with architect.

1. Receptacles shall be Hubbell, Leviton, or Pass & Seymour as follows:

DECORATOR / DECORA RECEPTACLES	**HUBBELL**	**LEVITON**	**P&S**
DECORATOR DUPLEX 20A, 125V NEMA 5-15R SELF GROUNDING	DR20	16362	26342
DECORATOR SIMPLEX 20A, 125V NEMA 5-15R SELF GROUNDING	---	1635	26361
ISOLATED GROUND DUPLEX 20A, 125V ORANGE NEMA 5-20R	IG20DRx	16362-IG	IG26362
CLOCK HANGER 15A-125V BROWN WITH STAINLESS STEEL PLATE WITH HANGER	HBL5235	5361-CH	S3733-SS
GFCI DUPLEX 20A, 125V SELF TESTING, FEED THRU CAPABLE, TAMPER RESISTANT FOR LOCATIONS REQUIRING TAMPER RESISTANT INSTALLATION OR AS INDICATED ON THE DRAWINGS	GFRST20	GFTR2	2097TR
GFCI DUPLEX 20A, 125V SELF TESTING, FEED THRU CAPABLE, TAMPER/WEATHER RESISTANT FOR INSTALLATION IN DAMP/WET LOCATION OR AS INDICATED ON THE DRAWINGS	GFTWRST20	GFWR2	2097TRWR
TAMPER RESISTANT DUPLEX 20A, 125V NEMA 5-20R	DR20WHITR	16362-SG	TR26362
SURGE PROTECTION 20A, 125V DUPLEX, BLUE NEMA 5-20R WITH AUDIBLE ALARM	HBL5362SA	7380-W	5362SP
USB CHARGER TYPE DUPLEX 20A, 125V TAMPER RESISTANT, DUAL USB TYPE A PORTS MIN. OF 5A USB OUTPUT, TAMPER RESISTANT	USB20A5x 5A OUTPUT	T5832* 3.6A OUTPUT	2097TRUSBA4* 2.1A OUTPUT
PLUG LOAD CONTROLLED RECEPTACLES 20A, 125V TAMPER RESISTANT WITH TWO CONTROLLED	DR20C2WHITR	16352-2PW	TR26362CDW

FACE			
PLUG LOAD CONTROLLED RECEPTACLES 20A, 125V TAMPER RESISTANT WITH ONE CONTROLLED FACE	DR20C1WHITR	16352-1PW	TR26362CHW
ARC FAULT CIRCUIT INTERRUPTER RECEPTACLES	AF20TRW	AFTR2-W	AF202TRW
GROUND FAULT CIRCUIT INTERRUPTER / ARC FAULT DUAL FUNCTION	AFGF20TR	AGTR2-W	AFGF202TR

C. Provide hospital grade, White receptacles where indicated on the drawings. Provide "Red" receptacles for receptacles on emergency power. Coordinate exact location with architect.

1. Receptacles shall be Hubbell, Leviton, or Pass & Seymour as follows:

HOSPITAL GRADE RECEPTACLES	**HUBBELL**	**LEVITON**	**P&S**
HOSPITAL GRADE DUPLEX 20A, 125V NEMA 5-20R TAMPER RESISTANT FOR ALL LOCATIONS OTHER THAN BEHAVIOR HEALTH	8300TRA	T8300	26342
HOSPITAL GRADE DECORATOR DUPLEX NEMA 5-20R TAMPER RESISTANT	2182TRA	16362-SG	26361
HOSPITAL GRADE DUPLEX 20A, 125V NEMA 5-20R WITH INTEGRAL WIRE LEADS FOR INSTALLATION IN ONLY BEHAVIOR HEALTH LOCATIONS TO COMPLY WITH NEC 517-18(c)	HBL8300SGA	8300-SG	IG26362
HOSPITAL GRADE SIMPLEX, 20A, 125V NEMA 5-20R	HBL8310	8310	S3733-SS
HOSPITAL GRADE SURGE PROTECTIVE 5-20R, NEMA 5-20R, DUPLEX	HBL8362SA	T8380-B	2097TR
HOSPITAL GRADE GFCI TAMPER RESISTANT 20A, 125V, NEMA 5-20R SELF TESTING, FEED THRU CAPABLE	GFTRST83	GFNL2-HG	2097TRWR
HOSPITAL GRADE GFCI TAMPER/WEATHER RESISTANT, SELF TESTING, FEED THRU CAPABLE	GFRTW83	GFWT2-HG	TR26362
HOSPITAL GRADE USB DUPLEX CHARGER, 20A, 125V NEMA 5-20R TAMPER RESISTANT WITH TWO USB TYPE A 2.0 PORTS 5.0A 5V DC DECORATOR TYPE	USB8300A5* 5A OUTPUT	T5382-HG* 3.6A OUTPUT	TR8300HUSB* 3.1A OUTPUT

2.4 OCCUPANCY SENSORS

A. Provide White dual technology wall mounted sensors, provide one of the following:

1. Single Pole:

a. Wattstopper #DSW301

2. Double Pole:

a. Wattstopper # DSW302

3. Dimmer:

a. Wattstopper #DW311

B. Provide dual technology ceiling sensor with low voltage controlling switch and power pack.

1. Single Button:

a. Wattstopper # DT300 Sensor, BZ150 Power Pack and LVSW101 Digital Switch

C. Provide Ultra Sonic Ceiling sensor for restrooms.

1. Wattstopper #UT3000, BZ150 Power Pack

2.5 DIGITAL TIMER SWITCHES

A. Provide Wattstopper TS-400-G digital timer. Locate in mechanical, electrical, MDF, and IDF rooms.

B. The time switch shall provide audible notification and visual notification (blink the room lights) prior to turning lights off.

C. The time switch shall have a 12-hour manual override setting.

2.6 COVERPLATES

A. Furnish and install coverplates on all outlet boxes. Oversize (Jumbo) coverplates are not acceptable.

B. Coverplates shall be smooth nylon and 302/304 smooth stainless steel in kitchen and coffee bar areas.

C. Provide Hubbell WP Series, Bell, Carlon or Leviton NEMA 3R weatherproof coverplates on all exterior wiring devices. Enclosure shall be suitable for wet locations when in use.

D. Coverplates shall be Hubbell SS Series, Leviton, Pass & Seymour 302/304 smooth stainless steel on all receptacles 30 amps and larger.

E. Stainless steel device plates shall be provided at locations with tile or stone walls.

PART 3 - EXECUTION

3.1 WIRING DEVICE MOUNTING HEIGHTS

A. Unless noted to the contrary on plans, or directed otherwise during the progress of the Work, wiring devices shall be set as follows:

1. Switches 42" above finished floor.
2. Wall mounted receptacles shall be installed vertically at 15 inches to the bottom outlet above finished floor unless otherwise noted or as required by local codes.
3. Wall telephone outlets shall be mounted 15 inches to the bottom above finished floor unless otherwise noted. Mount even with wall mounted receptacles.
4. At locations above counters, set devices at 6 inches above to the centerline counter tops, verify exact mounting height with the architect.

3.2 INSTALLATION (Refer to 26 05 33 for outlet box specifications).

A. Wall switches shall be set in a suitable steel box and shall be installed on the strike side of the door as finally hung, whether so indicated on the Drawings or not.

B. Receptacles shall be installed in a suitable steel box.

C. The Architect reserves the right to relocate wiring device up to a distance of 5 feet from the location shown, before rough-in, without additional cost.

D. Provide multi-gang device covers at locations where devices gang together.

E. Device locations are indicated schematically on the drawings along with the type and mounting height. Final locations and mounting heights shall be coordinated with the Architect on the jobsite, and with shop drawings of equipment, including equipment to be furnished and installed by the Owner. Devices installed in walls covered with vinyl, fabric wallpaper or other special finishes shall be coordinated and verified with the Architect on the job site.

F. Stranded wire termination to switches, receptacles, devices, and miscellaneous control devices shall be with an approved solderless terminal if clamp type securing is not possible (i.e., Sta-Con crimp on fork tongue connectors; Burndy Type TP-F).

G. Provide keyed switches in all common areas not monitored by the faculty (i.e., gym, corridors, cafeteria, commons natatoriums).

H. All 15 amp and 20-amp receptacles shall be tamper-resistant type.

I. All 20A and 120V receptacles in food service areas shall be GFCI.

J. Provide GFCI circuit breakers for all drinking fountain branch circuits where GFCI receptacles are not indicated on plan.

K. Provide ARC Fault circuit interrupters (AFCI) as required to comply with article 210.12 of NFPA 70. This shall include but not be limited to dwelling units and dormitories. AFCI breakers may be used.

L. Provide ground fault circuit interrupter (GFCI)/ARC Fault circuit interrupter (AFCI) dual function receptacles to comply with articles 210.8, 210.12 and 406.4 of NFPA 70.

M. Contractor shall indicate the circuit serving each wiring device. Provide a typewritten label located on the inside face of the coverplate for all recessed mounted devices and on the outside of the coverplate on all surface mounted devices.

END OF SECTION 262726

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SECTION 262813 - FUSES

PART 1 - GENERAL

1.1 SCOPE

A. Provide fuses as shown and scheduled and indicate by this specification section and other specifications sections.

B. The type of fuses include:

1. 600-volt current limiting.
2. 250-volt current limiting.

1.2 STANDARDS

A. ANSI

B. UL

1.3 ACCEPTABLE MANUFACTURERS

A. Eaton Bussmann

B. Mersen

1.4 SUBMITTALS

A. Shop drawings shall include, but not be limited to:

1. Cutsheets of all fuses showing ratings and fuse curves.

1.5 REQUIREMENTS OF REGULATORY AGENCIES

A. WORK IN ACCORDANCE WITH:

1. National Electrical Code.
2. Local, municipal, or state codes that have jurisdiction.

PART 2 - PRODUCTS

2.1 CURRENT - LIMITING FUSES

A. General: Provide 200,000 amp interrupting capacity current limiting fuses of the ampacity and voltage indicated and scheduled.

B. Mains, Feeders and Branch Circuits

1. Circuits 601 to 6000 ampere shall be protected by current limiting BUSSMANN HI-CAP Time Delay Fuses KRP-C. Fuses shall employ "O" ring as positive seals between the end bells and the glass melamine fuse barrel. The terminals shall be peened. Fuses shall be time-delay and must hold 500% of rated current for a minimum of 4 seconds, clear 20 times rated current in .1 seconds or less and be listed by Underwriters` Laboratories Inc., with an interrupting rating of 200,000 amperes r.m.s. symmetrical. The fuses shall be UL Class L.

C. Class J Fuses

1. Circuits 0 to 600 ampere shall be protected by current limiting BUSSMANN LOW-PEAK Dual Element Fuses LPJ. All dual-element fuses shall have separate overload and short-circuit elements. Fuse shall incorporate a spring activated thermal overload element having a 284-degree Fahrenheit melting point alloy and shall be independent of the short-circuited clearing chamber. The fuse must hold 500% of rated current for a minimum of 10 seconds and listed by Underwriters' Laboratories Inc., with an interrupting rating of 200,000 amperes rRMS symmetrical. The fuses shall be UL Class J.
2. Motor Circuits - All individual motor circuits rated 600 amperes or less shall be protected by BUSSMANN LOW-PEAK LPJ. The fuses for 1.15 service factor motors shall be installed in ratings approximately 125% of motor full current except where high ambient temperatures prevail, or where the motor drives a heavy revolving part which cannot be brought up to full speed quickly, such as large fans. Under such conditions the fuse should be 150% to 200% of the motor full load current. Larger H.P. Motor shall be protected by BUSSMANN Type KRP-C HI-CAP Time-Delay Fuses of the rating shown on the drawings. 1.0 service factor motors shall be protected by BUSSMANN LOW-PEAK Dual-Element Fuses LPJ installed in ratings approximately 115% of the motor full load current except as noted above. The fuses shall be UL Class LPJ or L. Circuit breaker panels shall be protected by BUSSMANN LOW-PEAK Dual-Element LPJ as shown on the drawings. The fuses shall be UL Class J.

D. Class RK1 Fuses

1. Circuits 0 to 600 ampere shall be protected by current limiting BUSSMANN LOW-PEAK Dual Element Fuses LPN-RK (250 volts) or LPS-RK (600 volts). All dual-element fuses shall have separate overload and short-circuit elements. Fuse shall incorporate a spring activated thermal overload element having a 284-degree Fahrenheit melting point alloy and shall be independent of the short-circuited clearing chamber. The fuse must hold 500% of rated current for a minimum of 10 seconds and listed by Underwriters' Laboratories Inc., with an interrupting rating of 200,000 amperes RMS symmetrical. The fuses shall be UL Class RK1.

2. Motor Circuits - All individual motor circuits rated 600 amperes or less shall be protected by BUSSMANN LOW-PEAK Dual Element Fuses LPN-RK (250 volts) or LPS-RK (600 volts). The fuses for 1.15 service factor motors shall be installed in ratings approximately 125% of motor full current except where high ambient temperatures prevail, or where the motor drives a heavy revolving part which cannot be brought up to full speed quickly, such as large fans. Under such conditions the fuse should be 150% to 200% of the motor full load current. Larger H.P. Motor shall be protected by BUSSMANN Type KRP-C HI-CAP Time-Delay Fuses of the rating shown on the drawings. 1.0 service factor motors shall be protected by BUSSMANN LOW-PEAK Dual-Element Fuses LPN-RK (250 volts) or LPS-RK (600 volts) installed in ratings approximately 115% of the motor full load current except as noted above. The fuses shall be UL Class RK1 or L.
3. Circuit breaker panels shall be protected by BUSSMANN LOW-PEAK Dual-Element LPN-RK (250 volts) or LPS-RK (600 volts) as shown on the drawings. The fuses shall be UL Class RK1.

2.2 SPARES

A. Upon completion of the building the contractor shall provide the owner with spare fuses as shown below.

1. 10% (minimum of 3) of each type and rating of installed fuses shall be supplied as spares.
2. BUSSMANN spare fuse cabinets - Catalog No. SFC - shall be provided to store the above spares.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Fuses: Fuses shall not be installed until equipment is ready to be energized. This measure prevents fuse damage during shipment of the equipment from the manufacturer to the job-site or from installation. All fuses shall be furnished and installed by the electrical contractor. All fuses shall be of the same manufacturer.

B. All fuses shall be installed in fuse holders.

END OF SECTION 262813

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SECTION 262816 - SAFETY AND DISCONNECT SWITCHES

PART 1 - GENERAL

1.1 SCOPE

A. Provide safety and disconnect switches as shown, scheduled, and as specified herein.

1.2 STANDARDS

A. Products shall be designed, manufactured, tested, and installed in compliance with applicable standards.

1. NEMA KS1 - Enclosed switches
2. Federal specification W-S-865C-Heavy duty switches

B. Products shall conform all applicable UL standards, including UL98 (standard for safety, enclosed and dead front switches) and shall be UL-labeled.

1.3 ACCEPTABLE MANUFACTURERS

A. Provide one of the following manufacturers:

1. General Electric Company/ABB
2. Square D Company
3. Siemens
4. Cutler Hammer

1.4 SUBMITTALS

A. Shop drawings shall include, but not be limited to:

1. Cutsheets of switches with ratings, physical dimensions and all accessories clearly labeled.

1.5 REQUIREMENTS OF REGULATORY AGENCIES

A. WORK IN ACCORDANCE WITH:

1. National Electrical Code.
2. Local, municipal, or state codes that have jurisdiction.

PART 2 - PRODUCTS

2.1 GENERAL

A. Furnish and install heavy duty type safety switches with the number of switched poles as indicated on the plans and specifications. All safety switches shall be NEMA Heavy Duty Type HD, and Underwriters Laboratories listed.

2.2 MATERIALS AND COMPONENTS

A. Switch Interior

1. All switches shall have switch blades that are fully visible in the "OFF" position when the door is open. Switches shall have removable arc suppressor where necessary, to permit easy access to line side lugs. Lugs shall be front removable and UL listed for 60ºC and 75ºC copper or aluminum cables. All switches' blades and contacts shall be plated copper. Adjust fuse block to accept Class J fuses.

B. Switch Mechanism

1. Switches shall have a quick-make and quick-break operating handle and mechanism, which shall be an integral part of the box, not the cover. Padlocking provisions shall be provided for locking in the "OFF" position with at least three padlocks. Switches shall have a dual cover interlock to prevent unauthorized opening of the switch door when the handle is in the "ON" position, and to prevent closing of the switch mechanism with the door open. A means shall be provided to permit authorized personnel to release the interlock for inspection purposes. Handle position shall indicate if switch is "ON" or "OFF".

C. Neutral

1. Provide a solid neutral with the safety switch where a neutral is present in the circuit.

D. Ratings

1. Switches shall be horsepower rated for ac and/or dc as indicated by the plans. The fused switches shall have Class R rejection fuse clips or adjusted for Class J fuses. UL listed short circuit ratings of the switches, when equipped with Class R fuses, shall be 200,000 symmetrical amperes.

E. Enclosures

1. Indoor switches shall be furnished in NEMA 1 enclosures.
2. Outdoor switches, switches located in wet areas or sprinkled areas shall be furnished in NEMA 3R enclosures.
3. Switches installed in wet areas such as cooling tower areas shall be NEMA 4X stainless steel or fiberglass reinforced polyester.
4. Switches installed in kitchens shall be stainless steel.

5. Switches installed in areas of a corrosive nature and subjected to salt air shall be NEMA 4X stainless steel or fiberglass reinforced polyester.

F. Electrical Interlock Contacts

1. Provide electrical interlock contacts on all disconnect switches serving motors in which remote VFDs are serving the motor. Provide conductors from contacts to the safe circuit inside the VFD. De-energizing the disconnect switch shall signal VFD to stop.

G. Service Entrance

1. Switch shall be suitable for use as service entrance equipment when installed in accordance with the National Electrical Code.

PART 3 - EXECUTION

3.1 GENERAL

A. Install safety and disconnect switches, including electrical connections, and fuses in accordance with manufacturer’s written instructions, NEC, and recognized industry practices.

B. Location: Install switches within sight of controllers.

C. Hubs: Provide bolt-on hubs for rainproof or wet area applications.

3.2 IDENTIFICATION

A. Nameplate: Each disconnect switch shall have an engraved bakelite nameplate. Nameplates shall be white with black letters and show equipment served. Nameplates shall be attached with stainless steel screws.

END OF SECTION 262816

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SECTION 262926 - MISCELLANEOUS ELECTRICAL CONTROLS AND WIRING

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

1.2 SCOPE

A. Provide the various miscellaneous control devices, wiring and additional branch circuits as required, shown, and specified.

B. The types of miscellaneous control devices and wiring include but not limited to the following.

1. Contactors
2. Relays
3. Additional control wiring and safety devices as shown and specified.
4. Connect power from fire alarm relays to starters to shut down air handling units.

C. WORK SPECIFIED ELSEWHERE:

1. Various control devices, of an electrical nature, for the safe operation and temperature control of the heating, ventilating, air conditioning and plumbing systems provided under Division 22 and Division 23.
2. All control wiring and conduit shall be furnished under Division 23. All power wiring 120 volt or larger shall be provided by Division 26.
3. Refer to building controls specification, Division 23 for scope of work required to be performed by Division 26 (electrical contractor).
4. Specification 260519 - Wire, Cable, and Related Materials.

1.3 REFERENCE STANDARDS

A. NEMA ICS 2 - Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts; 2008 (Reaffirmed 2020).

B. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

C. UL 508 - Industrial Control Equipment; Current Edition, Including All Revisions.

D. UL 916 - Energy Management Equipment; Current Edition, Including All Revisions.

E. UL 924 - Emergency Lighting and Power Equipment; Current Edition, Including All Revisions.

1.4 REQUIREMENTS OF REGULATORY AGENCIES

A. WORK IN ACCORDANCE WITH:

1. NFPA 70
2. Local municipal or state codes that have jurisdiction.
3. UL 916
4. UL 924

1.5 ACCEPTABLE MANUFACTURERS

A. Provide one of the following manufacturers:

1. LIGHTING CONTACTORS AND RELAYS

a. General Electric Company/ABB
b. Square D Company
c. Siemens
d. Cutler Hammer

PART 2 - PRODUCTS

2.1 MATERIAL

A. GENERAL: This Section shall outline the basic installation of electric devices, conduit, boxes, fittings, and wiring required for complete interconnection of several systems; this may not reflect every required appurtenance. It does not cover integral parts of mechanical equipment.

B. CONTACTORS AND RELAYS: Provide control wiring, contactors, and relays with the ampere-rating and number of poles as shown, specified, and required for a complete and functioning system:

1. Rated at 600 volts, 60 hertz.
2. Continuously rated contacts for all types of ballast and tungsten lighting, resistance, and motor loads. Contacts shall be sized as scheduled or noted.
3. Shall have totally enclosed, double-break silver-cadmium-oxide power contacts. Auxiliary arcing contacts are not acceptable. Contact inspection and replacement shall be possible without disturbing line or load wiring.
4. The contactor shall have straight-through wiring with all terminals clearly marked.
5. The contactor shall be approved per UL 508 and/or CSA and be designed in accordance with NEMA ICS 2-21 1B.
6. They shall be industrial-duty rated for applications to 600 volts maximum.
7. The contactor shall have provisions for factory or field addition of:

a. Four (4) N.O. or N.C. auxiliary contacts rated 6 amperes continuous at 600 volts.
b. Single or double circuit, N.O. or N.C., 30 or 60 ampere 600-volt power-pole adder.

8. The contactor shall have a NEMA type 1 enclosure unless otherwise noted.
9. Control power to the contactor 120V control circuit shall be provided from the nearest panelboard 120V circuit. If the 120V control power circuit is not shown, provide a control power transformer for 120-volt control power and a 120-volt coil when required for control. Provide primary and secondary fuses on the control power transformer.
10. Electrically Held Lighting - Contactor coils shall be continuously rated and encapsulated. Electrically held contactors are not to be used unless specifically shown on the plans.
11. Mechanically Held Lighting Contactors - Coil-clearing contacts shall be supplied so that the contactor coils shall be energized only during the instance of operation. Both latch and unlatch coils shall be encapsulated. All contactors shall be mechanically held unless noted otherwise on the plans.
12. Provide 2-wire or 3-wire control modules as required to operate lighting contactors.
13. Provide hand-off-automatic controls (H-O-A) for each lighting contactor.
14. Provide relays and contactors to shut down air handling units.

C. Control wiring shall be not less than #14 AWG type THWN/THHN and shall be color coded and labeled with Brady markers throughout. Bundle multiple conductors with Ty-Raps.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install miscellaneous electrical controls and wiring to provide a functioning system.

B. Install contactor and relays in electrical/mechanical rooms unless otherwise noted.

C. Provide miscellaneous connections for signs and other furnished equipment as shown on the Drawings.

D. Provide NEMA 3R/4/4X/12 enclosures where located outside.

E. All Low-Voltage cabling, for all systems, shall be neatly routed using J-Hooks. Cabling is installed above a hard ceiling; conduit shall be used to traverse the hard-ceiling segments.

3.2 DIVISION 22, 23, 27 AND 28 MISCELLANEOUS POWER AND CONTROLS

A. Install electrical devices not an integral part of system equipment providing conduit, boxes, fittings, wiring, circuit breakers, disconnecting means and other devices.

B. Contractor is responsible for providing all line voltage power to devices that require electrical power to operate. Contractor shall terminate line voltage power to termination points. Contractor shall coordinate between all trades to determine sizing and quantities of line voltage circuits to adequately power and control devices. Provide circuits from nearest low voltage panel using spare circuits provided if device requires power not already available or indicated.

C. Provide GFCI receptacle with weatherproof cover within 25 feet of all heating, air conditioning and refrigeration equipment.

3.3 OPERATIONS PERSONNEL TRAINING

A. A one-time recommissioning site visit, 4 Hours in time, by a manufacturer technician anytime between 90 and 120 days of building occupancy to adjust and reprogram (as required) the system based on owner input. This meeting shall be scheduled by the manufacturer and can only be declined by the owner.

B. Provide a training session for the owner's operations personnel. Training session shall be performed by a qualified person who is knowledgeable in the subject/equipment. Submit a training agenda two (2) weeks prior to the proposed training session for review and approval. Training session shall include at the minimum:

1. Purpose of equipment.
2. Principle of how the equipment works.
3. Important parts and assemblies.
4. How the equipment achieves its purpose and necessary operating conditions.
5. Most likely failure modes, causes and corrections.
6. On-site demonstration.

END OF SECTION 262926

SECTION 263623 - AUTOMATIC TRANSFER SWITCHES WITH BYPASS ISOLATION

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

1.2 SCOPE

A. Provide automatic transfer & bypass-isolation switch (ATS/BPS) system(s) with number of poles, amperage, voltage, withstand and close-on ratings as shown on the plans. Each automatic transfer shall consist of an inherently double throw power transfer switch mechanism and a microprocessor controller to provide automatic operation. All automatic transfer & bypass-isolation switches and controllers shall be the products of the same manufacturer.

1.3 REQUIREMENTS

A. Level 1 applications are legally-required emergency systems. Level 2 applications are standby systems.

B. The electric generating system must meet all requirements of NFPA 110 including design specification, prototype tests, one-step full-load pickup, and installation acceptance. Engine-generator system to provide source of power for Level 1.

C. Comply with requirements of NFPA 99 as applicable.

D. Comply with requirements of IEEE 446 as applicable.

1.4 REFERENCE STANDARDS

A. IEEE 446 - Recommended Practice for Emergency and Standby Power Systems for Industrial and Commercial Applications; 1995.

B. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.

C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

D. NFPA 99 - Health Care Facilities Code; 2024, with Errata.

E. NFPA 110 - Standard for Emergency and Standby Power Systems; 2025.

F. UL 1008 - Transfer Switch Equipment; Current Edition, Including All Revisions.

1.5 SUBMITTALS

A. Shop drawings shall include but not be limited to:

1. Catalog cut sheets with all equipment, accessories and devices including all ratings.
2. Complete bill of materials.

B. Operation and Maintenance Data

1. Submit under provisions of Division One.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of Division One and in accordance with manufacturer's instructions.

B. Accept unit on site on skids. Inspect for damage.

C. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

D. Handle carefully in accordance with manufacturer's instructions to avoid damage to transfer switch components, enclosure, and finish.

1.7 WARRANTY

A. The transfer switch shall be warranted for a period of five years form the date of initial start-up.

1.8 ACCEPTABLE MANUFACTURERS

A. Provide products complying with these specifications and produced by one of the following:

1. ASCO
2. Cummins Power Generation/Onan

B. The ATS manufacturer shall maintain a national service organization of company-employed personnel located throughout the contiguous United States. The service center’s personnel must be factory trained and must be on call 24 hours a day, 365 days a year.

PART 2 - PRODUCTS

2.1 MECHANICALLY HELD TRANSFER SWITCH

A. The transfer switch unit shall be electrically operated and mechanically held. The switch shall be mechanically interlocked to ensure only one of the two possible positions, normal or emergency, may be held.

B. All main contacts shall be silver in composition.

C. Inspection of all contacts shall be possible from the front of the switch without disassembly of the operating linkages and without disconnection of power conductors. A manual operating handle shall be provided for maintenance purposes.

D. Designs utilizing components of molded-case circuit breakers, contactors, or parts thereof are not acceptable.

E. Where neutral conductors must be switched as shown on the plans, the AS shall be provided with fully rated overlapping neutral transfer contacts. The neutrals of the normal and emergency power sources shall be connected together only during the transfer and retransfer operation and remain connected together until power source contacts close on the source to which the transfer is being made. The overlapping neutral contacts shall not overlap for a period greater than 100 milliseconds. Neutral switching contacts which do not overlap are not acceptable.

2.2 BYPASS-ISOLATION SWITCH

A. A two-way bypass-isolation switch shall provide manual bypass of the load to either source and permit isolation of the automatic transfer switch from all source and load power conductors. All main contacts shall be manually driven.

B. Power interconnections shall be silver-plated copper bus bar. The only field installed power connections shall be at the service and load terminals of the bypass-isolation switch. All control interwiring shall be provided with disconnect plugs.

C. Separate bypass and isolation handles shall be utilized to provide clear distinction between the functions. Handles shall be permanently affixed and operable without opening the enclosure door. Designs requiring insertion of loose operating handles or opening of the enclosure door to operate are not acceptable.

D. Bypass to the load-carrying source shall be accomplished with no interruption of power to the load (make before break contacts). Designs which disconnect the load when bypassing are not acceptable. The bypass handle shall have three operating modes: "Bypass to Normal," "Automatic," and "Bypass to Emergency." The operating speed of the bypass contacts shall be the same as the associated transfer switch and shall be independent of the speed at which the manual handle is operated. In the "Automatic" mode, the bypass contacts shall be out of the power circuit so that they will not be subjected to fault currents to which the system may be subjected.

E. The isolation handle shall provide three operating modes: "Closed," "Test," and "Open." The "Test" mode shall permit testing of the entire emergency power system, including the automatic transfer switches with no interruption of power to the load. The "Open" mode shall completely isolate the automatic transfer switch from all source and load power conductors. When in the "Open" mode, it shall be possible to completely withdraw the automatic transfer switch for inspection or maintenance to conform to code requirements without removal of power conductors or the use of any tools.

F. When the isolation switch is in the "Test" or "Open" mode, the bypass switch shall function as a manual transfer switch.

G. Designs requiring operation of key interlocks for bypass isolation or ATSs which cannot be completely withdrawn when isolated are not acceptable.

2.3 MICROPROCESSOR CONTROL PANEL

A. The controller's sensing and logic shall be provided by a single built-in microprocessor for maximum reliability, minimum maintenance, and the ability to communicate serially through an optional serial communication module.

B. A single controller shall provide twelve selectable nominal voltages for maximum application flexibility and minimal spare part requirements. Voltage sensing shall be true RMS type and shall be accurate to ± 1% of nominal voltage. Frequency sensing shall be accurate to ± 0.2%. The panel shall be capable of operating over a temperature range of -20 to +60 degrees C and storage from -55 to +85 degrees C.

C. The controller shall be connected to the transfer switch by an interconnecting wiring harness. The harness shall include a keyed disconnect plug to enable the controller to be disconnected from the transfer switch for routine maintenance. Sensing and control logic shall be provided on multi-layer printed circuit boards. Interfacing relays shall be industrial grade plug-in type with dust covers. The panel shall be enclosed with a protective cover and be mounted separately from the transfer switch unit for safety and ease of maintenance. The protective cover shall include a built-in pocket for storage of the operator's manuals.

D. All customer connections shall be wired to a common terminal block to simplify field-wiring connections.

2.4 ENCLOSURE

A. Transfer switches / BPS shall be furnished in a NEMA 1 enclosure per NEMA 250.

2.5 VOLTAGE AND FREQUENCY SENSING

A. The voltage of each phase of the normal source shall be monitored, with pickup adjustable from 85% to 100% of nominal and dropout adjustable from 75% to 98% of pickup setting.

B. Single-phase voltage sensing of the emergency source shall be provided, with pickup voltage adjustable from 85% to 100% of nominal and independent frequency sensing with pickup adjustable from 90% to 100% of nominal.

2.6 ADDITIONAL FEATURES

A. A set of DPDT gold-flashed contacts rated 10 amps, 32 VDC shall be provided for a low-voltage start signal.

B. One set of auxiliary contacts rated 10 amps; 250 VAC shall be provided.

C. Position indicating lights shall be provided.

2.7 WITHSTAND AND CLOSING RATINGS

A. The ATS shall be UL listed in accordance with UL 1008 and be labeled in accordance with the standard's 3 cycle, long-time ratings. Transfer switches that are not tested and labeled with 3 cycle (any breaker) ratings and have series, or specific breaker ratings only, are not acceptable unless the switch performance is guaranteed and UL listed for molded case circuit breakers or current limiting fuses. If current limiting fuses are utilized, provide current limiting fuses, and disconnect switch mounted in or on the transfer switch.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Provide all power wiring, control wiring, additional contacts and relays required for a complete installation. All conduit shall be in a two-hour enclosure. Underground conduits shall be concrete encased.

B. Install in accordance with manufacturer's instructions.

C. Install in accordance with NFPA 70.

D. Provide engraved plastic nameplates under the provisions of Section 260200.

3.2 TESTS

A. Field Test After Installation:

1. The complete installation shall be initially started and checked out for operational compliance by factory-trained representatives of the engine-generator set and transfer switch manufacturer.

3.3 OPERATIONS PERSONNEL TRAINING

A. Provide a training session for the owner's operations personnel. Training session shall be performed by a qualified person who is knowledgeable in the subject/equipment. Submit a training agenda two (2) weeks prior to the proposed training session for review and approval. Training session shall include at the minimum:

1. Purpose of equipment.
2. Principle of how the equipment works.
3. Important parts and assemblies.
4. How the equipment achieves its purpose and necessary operating conditions.

5. Most likely failure modes, causes and corrections.
6. On site demonstration

B. Training

1. Provide training designed for a minimum of four persons, to include:
2. Training in the system operation in all possible configurations.
3. Training in the maintenance of the system.
4. Minimum of four hours of instruction, but sufficient to cover all items specified.
5. Four sets of instruction materials.

END OF SECTION 263623

SECTION 265119 - LIGHTING FIXTURES - LIGHT EMITTING DIODE (LED)

PART 1 - GENERAL

1.1 SCOPE

A. Provide general and emergency lighting fixtures as noted on the drawings. Fixtures shall be completely wired with lamps installed and shall be in perfect operating condition at the time of substantial completion.

B. The types of lighting fixtures required for this project include:

1. LED

1.2 REFERENCE STANDARDS

A. 47 CFR 15 - Radio Frequency Devices; current edition.

B. NEMA JSC 10410 - Performance Testing for Lighting Controls and Switching Devices with Electronic Drivers and Discharge Ballasts; 2023.

C. UL 924 - Emergency Lighting and Power Equipment; Current Edition, Including All Revisions.

D. UL 1008 - Transfer Switch Equipment; Current Edition, Including All Revisions.

E. UL 1012 - Safety Power Units Other Than Class 2; 2010.

F. UL 1310 - Class 2 Power Units; Current Edition, Including All Revisions.

G. NFPA 101

H. NEMA-LE

I. TM-21

J. LM-80

K. LM-79

L. L70

M. DLC

1.3 QUALITY ASSURANCE

A. All fixtures shall conform to all applicable UL standards and shall be UL label including damp and wet location ratings. “ETL listed” is an acceptable listing.

B. All LED drivers shall be UL recognized Class 2 per UL 1310 or non-Class 2 per UL 1012 as applicable.

C. All LED drivers shall comply with applicable requirements of the Federal Communications Commission (FCC) rules and regulations, Title 47 CFR 15, for Non-Consumer Equipment.

D. All LED drivers shall be RoHS compliant.

1.4 ACCEPTABLE MANUFACTURERS

A. Provide lighting fixtures produced by manufacturers as shown and scheduled.

B. LED DRIVER:

1. Provide one of the following manufacturers

a. Eldo
b. Lutron
c. Osram
d. Philips

C. LAMPS:

1. Provide one of the following LED Chip manufacturers

a. Cree
b. Nichia
c. North American Philips
d. Seoul
e. Lumileds

1.5 SUBMITTALS

A. Shop drawings shall include a brochure with a separate cut sheet for each fixture type arranged in alphabetical order with fixture and all accessories/options clearly labeled. Provide performance data for each fixture. Provide an independent test lab report for each fixture if requested by the Architect/Engineer.

B. Provide driver and LED module data brochures for each fixture type.

C. Provide air handling and heat removal data for light fixtures specified with these requirements.

1.6 REQUIREMENTS OF REGULATORY AGENCIES

A. WORK IN ACCORDANCE WITH:

1. National Electrical Code.
2. Local, municipal, or state codes that have jurisdiction.
3. UL fire resistance directory.

PART 2 - PRODUCTS

2.1 MATERIALS AND COMPONENTS

A. General:

1. Provide the size, type and rating of each light fixture shown and scheduled. All light fixtures shall complete with reflectors, lens, trim rings, flanges, LED modules, lamp holders, drivers, fuses, wiring, earthquake clips, etc. to provide a complete functioning light fixture.

B. Lighting Fixture Types:

1. LED Fixtures

a. Fixtures shall be pre-wired with frame-in kit and integral thermal management system for fixtures. Driver shall be encased in metal-can construction for optimal thermal performance.
b. Total fixture lumen output is dependent on the chip, thermal management, driver current and optical system. LED fixtures shall be tested as a complete unit or system. Only DOE recognized CALiPER testing laboratory results shall be utilized.
c. Interior LED fixtures shall have integral common mode and differential mode surge protection of 3kV(1.2/50µs, 2-ohm combination wave).
d. Exterior LED fixtures shall have integral common mode and differential mode surge protection of 10kV/10kA(1.2/50µs, 2-ohm combination wave).

2. Exit signs

a. Exit signs shall meet all federal, state, and local codes.
b. Provide fire alarm interface relay when required to flash exit signs.
c. Provide battery packs for emergency operation when not connected to emergency generator power.

2.2 LED MODULES AND DRIVERS - COORDINATE WITH LIGHT FIXTURE SCHEDULE

A. LED

1. Driver manufacturer shall have a 10-year history producing electronic drivers for the North American market.
2. Driver shall carry a five-year limited warranty from date of manufacture against defects in material or workmanship (including replacement) for operation at a maximum case temperature of 80 degrees Celsius.
3. Drivers shall not contain any Polychlorinated Biphenyl (PCB).
4. Provide driver with integral color-coded leads.
5. Driver shall operate from 50/60 Hz input source of 120 Volt through 277 Volt or 347 Volt through 480 Volt with sustained variations of +/- 10% (voltage) with no damage to the driver.
6. Driver output shall be regulated to +/- 5% across published load range. And shall have a power factor greater than .90 for primary application to 50% of full load rating with an input current Total Harmonic Distortion (THD) of less than 20% to 50% of full load rating.
7. Provide drivers with a Class A sound rating.
8. Provide LED drivers for outdoor fixtures with a minimum operating temperature of -40 degrees Celsius (-40 F). Provide LED drivers for indoor fixtures with a minimum operating temperature of -20 degrees Celsius (-2F).
9. Drivers shall tolerate sustained open circuit and short circuit output conditions without fail and auto-resetting without need for external fuses or trip devices.
10. Driver output ripple current shall be less than 15% measured peak-to-average, with ripple frequency being greater than 100Hz.
11. Driver performance requirements shall be met when operated to 50% of full load rating.
12. Driver shall have integral thermal foldback to reduce driver power above rated case temperature to protect the driver if temperatures reach unacceptable levels.
13. Drivers shall comply with NEMA JSC 10410 for in-rush current limits.
14. Dimmable drivers shall be controlled by a Class 2 low voltage 0-10VDC controller with dimming range controlled between 1 and 8VDC with source current 150µA.

2.3 LAMPS - COORDINATE WITH LIGHT FIXTURE SCHEDULE

A. LED Lamps shall be appropriately matched to the driver with junction-down design for improved thermal management. Maximum DC Forward Current.

2.4 BRANCH CIRCUIT EMERGENCY TRANSFER SWITCH (BCELTS)

A. Provide 20-amp, 120-277 Volt, UL 1008 listed Branch Circuit Emergency Transfer Switch to control emergency light fixtures transferring from normal to emergency branch circuits Provide Bodine GTD 20A or ETC SC 1008 UL 924 Devices are not acceptable

2.5 AUTOMATIC LOAD CONTROL RELAY (ALCR)

A. Provide 3-amp, 120-277 volt UL 924 listed. Relay to bypass switching controlling emergency branch circuit light fixtures Provide Bodine GTD or Wattstopper ELCU.

PART 3 - EXECUTION

3.1 INSTALLATIONS

A. General

1. Install the type of lighting fixture where shown and indicated in accordance with manufacturer's written instructions.
2. Provide earthquake clips on all recessed lay-in lighting fixtures as required by building code.
3. Adjust all adjustable lighting fixtures, as directed by the Architect.
4. Provide safety chains and wire guards for lighting fixtures located in gymnasium, multi-purpose rooms, play areas, etc.

B. Coordination

1. The contractor shall verify the type of fixtures with the ceiling types as indicated on the drawings. Any discrepancies shall immediately be brought to the architect's attention before the contractor places his order and accepts delivery. Fixtures shall fit exactly in the type of ceiling scheduled. Provide plaster frames, trim rings and other accessories required for a correct fit.
2. Provide supports attached to structural member to support fixtures when the ceiling system cannot maintain support. Provide separate supports for all recessed ceiling mounted HID fixtures.
3. Refer to architectural reflected ceiling plan for the exact location of all lighting fixtures. Notify the architect for any discrepancies or conflicts with structural, architectural, mechanical piping or ductwork before installation.

C. Mounting

1. Provide support channels to support outlet boxes used support surface mounted lighting fixtures such as exit signs or downlights.
2. Pendant or surface mounted fixture shall be provided with required mounting devices and accessories, including hickeys and stud-extensions, ball-aligners, canopies, and stems. Locations of fixtures in mechanical areas shall be coordinated with mechanical contractor. Mounting stems of pendant fixtures shall be of the correct length to uniformly maintain the fixture heights shown on the drawings or established in the field. The allowable variation tolerance in mounting individual fixtures shall not exceed 1/4 inch and shall not vary more than 1/2 inch from the floor mounting height shown on the Drawings. Fixtures hung in continuous runs shall be installed absolutely level and in line with each other. Hanging devices shall comply with Code requirements. Fixtures shall employ single - not twin - stem hangers unless otherwise noted.
3. All structure mounted fixtures (i.e., bracket mounted, pipe mounted and surface mounted) shall be provided with cables of suitable size and weight to support the weight of the fixture. Cables shall be fastened around or fastened to the housing of the fixture. On pendant fixtures, one safety cable of suitable size and weight to support the weight of the fixture assembly shall connect the top of the pendant to the supporting structure by means of welding or bolting, and one safety cable shall connect the housing of the fixture to the bottom of the pendant. Where more than one pendant per fixture occurs, only one

pendant must be cabled. Track fixtures for pendant mounted track shall also be supplied with clip-on safety cables of suitable size and weight to support the weight of the fixture.

4. Ground mounted flood type fixtures and flagpole lights, or similar fixtures, shall include stanchion and knuckle mount. Stanchion shall be supported by concrete base.

D. Electrical Connection

1. All light fixtures shall be connected from a branch circuit junction box using 1/2" flexible metal conduit or MC cable fixture pigtails not exceeding 8'- 0". Provide #12 AWG conductors. All fixtures must be grounded by using a grounding conductor. Fixture to fixture wiring of fixtures installed in accessible ceiling is not permitted. Fixture whips shall not lay-on ceiling tile or grid. Provide caddy clips to provide additional support.

3.2 FINAL INSPECTION

A. Remove all plastic and protective coating from all fixtures. Fixtures shall be thoroughly cleaned. Replace any damaged fixture or fixture parts including reflectors, louvers, lens, and metal parts that show signs of corrosion.

B. Replace all other defective fixtures showing signs of excessive usage.

C. Demonstrate proper operation of all fixtures and controls. Refer to other sections and details on the drawings for lighting controls.

END OF SECTION 265119

SECTION 270000 - GENERAL TECHNOLOGY REQUIREMENTS

PART 1 - GENERAL

1.1 PROJECT SUMMARY

A. Scope: Successful bidder shall provide, install, configure, and provide warranty service for technology systems described herein.

1.2 RELATED DOCUMENTS

A. Documents: Provisions of General Conditions, Supplementary Conditions, and the sections included under Procurement & Contract Requirements are included as part of this section as though bound herein.

1.3 RELATED WORK

A. Section 270500 – Communications General Requirements

B. Section 270526 – Grounding and Bonding for Technology Systems

C. Section 270528 – Pathways for Technology Systems

D. Section 270537 – Firestopping for Technology Systems

E. Section 271100 – Communications Equipment Rooms

F. Section 271300 – Communications Backbone Cabling

G. Section 271500 – Communications Horizontal Cabling

H. Section 271600 – Communications Connecting Cords

I. Section 271800 – Communications Labeling and Identification

J. Section 274000 – AV/Multimedia General Requirements

K. Section 274100 – Audio Visual Systems

L. Section 275100 – Distributed Communications Systems

M. Section 276000 – Physical Security General Requirements

N. Section 276200 – Electronic Access Control System

O. Section 276400 – Video Surveillance System

P. Section 276600 – Intrusion Detection System

1.4 DEFINITIONS

A. Approved or Approval: Where approval is called for, only persons with the authorized authority may grant approval. Owner reserves all rights to govern over and grant approval and will appoint authority of agents acting on their behalf.

B. As Required: Contractor shall provide the quantity of the said item that is necessary. Owner and Consultant reserve the right to make the final determination of necessary quantities to provide for a complete system.

C. Basis of Design: The documentation of the concepts, calculations, decisions, and product selections used to meet the Owner's project requirements. These Consultant produced documents are not shop drawings. Product selections depict minimum functionality and overall quality and are open to substitution requests.

D. Consultant: True North Consulting Group.

E. Contractor: The qualified party responsible for providing all items and performing services as described within these documents. Contractor referred to within a specific specification section shall be the successful qualified party contracted to perform and complete that work.

F. Documents: The complete package of Bid and Contract Requirements, General Technology Requirements, related Division 27 sections, drawings, schedules, and addenda that make up this Request for Bid.

G. End-User: Individual(s) who will ultimately operate the completed system.

H. ETR: Existing to Remain. Item is to remain in current location and maintain current functionality.

I. Furnish: To supply and deliver to the project site, ready for installation.

J. Install: To place in a position of service or use.

K. NIC: Not in Contract. Item will be the responsibility of others.

L. Notice to Proceed: Formal communication from the Owner to Contractor stating the date Contractor can begin work subject to the conditions of the contract. The performance time of the contract starts from the Notice to Proceed date.

M. OFCI: Owner Furnished Contractor Installed. Item will be provided by Owner and shall be installed by Contractor.

N. OFE: Owner Furnished Equipment. Item will be provided and integrated by the Owner.

O. OFOI: Owner Furnished Owner Installed. Item will be provided and installed by the Owner.

P. Owner: The party named in the Procurement and Contract Requirements as the advertising party.

Q. Provide: To furnish and install, complete and ready for the intended use.

R. Substantial Completion: The stage in the progress of installation when the systems described herein are sufficiently complete, in accordance with the Contract Documents, so that the Owner can utilize such systems for their complete intended use.

S. Turnkey: Of or involving the provision of a complete product or service that is ready for immediate use.

T. Work: The provision of products and/or services to meet the requirements specified in these documents.

1.5 REFERENCE STANDARDS AND CODES

A. Standards and other procedures referenced by this bid package are as follows:

1. ADA – Americans with Disabilities Act of 2010
   www.ada.gov/2010ADAstandards_index.htm
2. AIA – American Institute of Architects
   www.aia.org
3. ANSI – American National Standards Institute
   www.ansi.org
4. ASTM – American Society of Testing and Materials
   www.astm.org
5. BICSI – Building Industry Consulting Service International, Inc.
   (RCDD Standards)
   www.bicsi.org
6. CFR – Code of Federal Regulations
   www.gpo.gov/fdsys/browse/collectionCfr.action?collectionCode=CFR
   (Available from the Government Printing Office)
   (Material is usually first published in the Federal Register)
7. U.S. Copyright Law, December 2011
   www.copyright.gov/title17
8. ECIA – Electronic Components Industry Association
   ESC – EIA Standards Council
   www.eciaonline.org
9. IACS – International Annealed Copper Standard
   www.ndt-ed.org/GeneralResources/IACS/IACS.htm
10. IEC – International Electrotechnical Commission
    www.iec.ch
11. IEEE – Institute of Electrical and Electronics Engineers
    standards.ieee.org
12. ISO – International Organization for Standardization
    www.iso.org
13. ITU-T – International Telecommunication Union – Telecommunication
    www.itu.int
14. NEC – National Electrical Code (NFPA 70)
    maintained by NFPA – National Fire Protection Association
    www.nfpa.org

15. NECA – National Electrical Contractors Association
    www.necanet.org
16. NEMA – National Electrical Manufactures' Association
    www.nema.org
17. OSHA – Occupational Safety and Health Administration
    (U.S. Department of Labor, OSHA)
    www.osha.gov
18. TIA – Telecommunications Industry Association
    www.tiaonline.org/standards
19. UL – Underwriters' Laboratories
    www.ul.com

B. Standards: Referenced standards and/or procedures shall be binding on Contractor, and work shall be judged against such standards and procedures unless otherwise stated in writing.

C. Local/State Codes: Contractor shall comply with all local and state code requirements as determined by the authority having jurisdiction (AHJ).

D. Owner Standards: Contractor shall obtain and abide by all published Owner standards as the y pertain to the work described herein.

E. Contractor shall use the latest versions of all standards and codes unless otherwise directed by the authority having jurisdiction (AHJ) or expressly noted herein.

1.6 QUALIFICATIONS

A. Horizontal cabling, Contractor must be CommScope Gold Uniprise and Systemax Certified.

B. Access Control: Open Option Certified with a minimum of 3 technicians certified in DNA fusion.

C. Cameras: Silver level able to provide a 5-year repair warranty. And 1-year advanced replacement. A minimum of 2 wisent certified technicians.

1.7 PERMITS AND INSPECTIONS

A. Responsibility: Obtain permits and inspections required for the work. Contractor is responsible for all permit and inspection costs.

B. Performance: Perform tests required herein or as may be reasonably required to demonstrate conformance with the specifications or with the requirements of any legal authority having jurisdiction.

C. Review: Obtain approvals from authorities responsible for enforcement of applicable codes and regulations to establish that the work is in compliance with all requirements of reference codes indicated herein and required by the appropriate jurisdiction. Make corrections, changes, or additions as required and deliver certificates of acceptance, operation, and/or compliance with the Operation and Maintenance Manuals described herein.

1.8 DRAWINGS AND BASIS OF DESIGN

A. General: Work, equipment, or material delineated on any drawing in this package is expected to be provided by Contractor unless noted otherwise.

B. Interpretation: Work shall be installed in accordance with the basis of the design diagrammatically expressed on the drawings and described in the written specifications and equipment schedule(s). Contractor shall not make limiting interpretation that provides for incomplete work or a non-functioning system.

1.9 PRODUCT SUBSTITUTION PROCEDURES

A. Requests for Substitutions: Should Contractor request a change in the material that is to be supplied from that which was specified in the contract, Contractor shall provide the Owner and the Consultant with a written request for said change. Contractor will provide such a request prior to the bid due date. Contractor must provide enough time for the Owner and consultant to review the request. The owner's approval will be communicated via Addendum.

B. Substitutions for Non-specified Products: Where no product specification is provided, Contractor may use the manufacturer’s specification for the identified product as a guide for suggesting appropriate substitutions.

C. Requirements: The Request for Substitution shall include:

1. Reason for substitution.
2. Material data sheets for both the proposed item(s) and the item(s) to be replaced.
3. Any cost impact to the Owner.

D. Changes: Proposed changes to Contract Documents shall be clearly identified in the pre-construction submittals.

E. Approval: The Owner may approve or deny any Requests for Substitution. The Owner reserves the right to govern over and proclaim whether proposed products are equal to the specifications. Contractor shall not procure any substitute materials until the Owner has approved and signed the Request for Substitution and passed copies to Contractor and the Consultant. Any procurement or work performed prior to this approval is at Contractor’s own risk.

F. Deviation: Products provided or installed that deviate from the products specified in make, model, color, or other significant characteristics (i.e., non-approved substitutions) shall be removed and replaced with specified products at no additional expense to the Owner.

1.10 SUBMITTAL CONDITIONS

A. The Contractor shall not consider the Consultant or Owner’s review of submittals to be exhaustive or complete in every detail. Approval of shop drawings or submittals, including substitutions, indicates only the acceptance of the Contractor’s apparent intent to comply with the general design or method of construction and quality as specified. The finished product shall meet

functional requirements, operations, arrangements, and quantities and comply with the contract documents unless specifically approved otherwise.

B. The Contractor shall be held responsible for the delivery of systems as specified. Any errors or omissions in the submittals shall not relieve the Contractor of responsibility to deliver complete systems as specified.

1.11 PRE-CONSTRUCTION PROCEDURES

A. Pre-Construction Submittal Meeting: The Contractor shall schedule a web conference (WebEx or similar) with the Consultant to review the basis of design and submittal expectations.

B. Prior to Work: Pre-construction submittals shall be provided to the Consultant with appropriate promptness as to cause no delay to the work.

C. Project Timeline: The project timeline will not be altered due to the lateness of submittals. The Contractor is bound to deliver a timely, complete, and finished project as stipulated in their contract and specified herein.

D. Format and Distribution: The Contractor shall provide one (1) electronic copy in PDF format to the Consultant of all pre-construction submittals. The Contractor shall provide hard copy sets as required up to five (5) sets.

E. Provision: The Contractor shall submit pre-construction submittals, including any corrections or additions, to the Consultant prior to the procurement of equipment or commencement of work.

F. Review: Pre-construction submittals shall be received and formally approved by the Consultant prior to the procurement of material or the commencement of work. Any procurement or work performed prior to this approval is at The Contractor’s own risk.

G. Failure to Provide: The failure of Contractor to provide pre-construction submittals as required herein may result in the withholding of payment for work and/or the cancellation of the contract.

1.12 PRE-CONSTRUCTION SUBMITTALS

A. Pre-construction submittals are intended to document the details of installation. Exact copies of original drawings and specifications are not acceptable as pre-construction submittal drawings. Consultant schematic diagrams describe the basis of design as defined herein.

B. Contractor shall provide to the Consultant the following pre-construction submittals for approval in addition to specific requirements identified in subsequent sections.

1. Qualifications: This shall include documentation of all required qualifications.
2. BOM: Bill of materials with quantities, product parts (Matching product data), and description. BOM must be submitted in the same structure format as the product data.
3. Shop Drawings:

a. Title: Each drawing shall have a descriptive title, and all subparts of each drawing shall have unique identifiers.
b. Floor Plans: Shall include device locations, Contractor provided furniture and installation notes.
c. System Drawings: Shall include functional diagrams for each system detailing system flow, including all equipment, routing, inputs/outputs, wiring signal type, cable identification detail, connectors, adapters, intra/inter-rack power distribution, installation notes, and any other information required to convey the complete turnkey system design.
d. Equipment Rack and Cabinet Elevations: Shall include placement of all mounted equipment.
e. Structurally Mounted Elements: Shall include both a plan view of placement as well as a detail of structural mounting techniques to be used.
f. Furniture: Shall include all provided furniture showing dimensional drawings, cable management, and finishes with samples for Owner approval.

4. Product Data:

a. Equipment Schedules: Shall include manufacturers, part numbers, quantities, and unit pricing.
b. Product Cut Sheets: Shall identify (highlight, arrow, etc.) actual part numbers to be utilized, including but not limited to equipment, mounting hardware, cabling, connectors, software, and power distribution equipment.

5. Manufacturer's Recommendations:

a. Where installation procedures or any part of the roof are required to be in accordance with the recommendations of the manufacturer of the material being installed, copies of these recommendations shall be provided prior to installation. Installation of the items will not be allowed to proceed until the recommendations are received and approved.

1.13 PRE-INSTALLATION PROCEDURES

A. Refer to individual sections for additional information.

1.14 CONSTRUCTION PROGRESS PROCEDURES

A. Meeting Attendance: The Contractor is required to attend job progress meetings in accordance with requirements set by the Owner or Consultant.

B. Additional Coordination: Contractor shall request additional job construction coordination meetings it deems to be necessary to ensure coordination of their responsibilities with other parties.

C. Progress Inspection: Consultant may perform periodic progress inspections. At the Consultant's request, Contractor shall make the Project Manager and/or Lead Technician available.

D. Test Plan: Ten (10) business days prior to the proposed test date, Contractor shall provide a test plan defining the tests required.

1. The test plan shall be approved by the Consultant prior to any testing.

1.15 CONSTRUCTION PROGRESS SUBMITTALS

A. Completion: Contractor shall complete and submit via email all construction progress documentation in PDF format as requested by the Owner and Consultant.

B. The Contractor shall provide to the Consultant the following construction progress submittals in addition to specific requirements identified in subsequent sections.

1. Weekly Report: Weekly written report to be submitted to the Consultant through appropriate project channels in PDF format outlining progress from the previous week, plans for progress in the current week, and any coordination issues that may require the Consultant or Owner's attention.
2. Test Plan: Shall ensure the system meets the Owner's operational and performance specifications and include the following:

a. Identification of the capabilities and functions to be tested.
b. Detailed instructions for the setup and execution of each test.
c. Procedures for evaluation and documentation of the results.

C. Failure to Complete: Failure to complete requested construction progress documentation may result in the withholding of payment by the Owner.

1.16 CLOSEOUT PROCEDURES

A. Notification: The Contractor shall provide written notification to the Consultant and Owner when the Contractor is satisfied that the work has reached Substantial Completion and is ready for inspection.

B. Pre-Inspection Submittals: The Contractor shall submit an electronic copy of all closeout submittals to the Consultant in accordance with the requirements found in these documents no less than ten (10) business days prior to the scheduled Final Inspection.

1. Test Results
2. As-built drawings (full-size sheets)
3. Operation and Maintenance Manuals
4. End User Software

C. Photos that demonstrate complete system installation.

D. Punch List: Work or materials found to be incomplete, of unsatisfactory quality, failing to meet the specifications in these documents, and/or unacceptable to the Consultant or Owner shall be documented by the Consultant and provided to the Contractor to rectify at no additional cost. The

Contractor shall provide written notification to the Consultant and Owner when all punch list items have been completed.

E. Final Inspection: At the Consultant's request, the Contractor shall make the Project Manager and/or Lead Technician available.

F. Re-Inspection: If more than one (1) re-inspection is necessary, the costs of the additional travel, time, and expenses of the Owner and Consultant may be deducted by the Owner from the contract amount due to the Contractor.

G. Punch List Approval: Once all punch list items are complete, the Contractor shall return an initialed punch list to the Consultant and Owner for verification. The punch list shall be considered complete only after having been signed by the Owner and Consultant.

H. Closeout Submittals: Upon approval of closeout submittals and prior to final acceptance, The Contractor shall provide three (3) electronic copies to the Owner and Consultant in the format(s) noted below.

1. Record Drawings – AutoCAD 2010 editable .dwg format AND PDF. -USB
2. Operation and Maintenance Manuals – USB
3. End User Software – USB.
4. Documentation of testing and system certification.- USB

I. Closeout Submittal Format and Distribution: Upon approval of closeout submittals and prior to final acceptance, the Contractor shall provide a total of three (3) bound hard copies and one (1) digital copy with labeled dividers of all record drawings (full-size sheets) and operation and maintenance manuals, three (3) copies to Owner and one (1) digital copy to Consultant. The title on the front and spine of the binder shall be "Operation and Maintenance Manual – [Project Name]." The following additional items shall be identified on the binder cover:

1. Client Name
2. Contractor Name and Contact Information
3. Consultant Name and Contact Information
4. Date

J. All documentation prepared by the Contractor, including hard copy and electronic forms, shall become the property of the Owner.

K. Payment Authorization: Final payment will be authorized only after all closeout procedures and requirements have been followed and fulfilled by The Contractor and approved in writing by the Owner and Consultant, including punch list(s) and/or re-inspection(s) and delivery of closeout deliverables.

1.17 CLOSEOUT SUBMITTALS

A. Closeout submittals are intended to document the details of the final installation that substantially conforms to the construction documents and functions as intended to meet the Owner's needs.

B. The Contractor shall provide to the Consultant the following closeout submittals for approval in addition to specific requirements identified in subsequent sections.

1. As-built drawings: As-built drawings are prepared by Contractor. The y show, in red ink, on-site changes to the Consultant-approved pre-construction submittal documents. As-built drawings shall be submitted to the Consultant for approval prior to submitting record drawings and include:

    a. Changes made by Addenda, Change Orders, Requests for Information (RFIs), Architect's Supplemental Instruction (ASIs), or Requests for Proposal (RFPs) in addition to any other changes to the original documents.
    b. Actual device locations, conduit routing, wiring, and relationships as they were constructed.
    c. Nomenclature showing as-built wire designations and colors.
    d. Room numbers coinciding with Owner space planning numbering.

2. Record drawings: Record drawings are the final drawings prepared by the Contractor and incorporate all as-built drawing changes previously approved by the Consultant. Record drawings should be electronically produced without any handwritten, red ink, or clouded changes.
3. Operation and Maintenance Manuals: Notwithstanding requirements specified elsewhere, submit one (1) copy of each of the following per binder:

    a. A final Bill of Materials for each system.
    b. A Microsoft Excel (.xlsx format) spreadsheet for each device that resides on the network provides the following:

        1) IP Address
        2) MAC Address
        3) Serial Number
        4) Manufacturer
        5) Model Number
        6) Device Username
        7) Device Password
        8) Telecom Closet or Rack Location
        9) Patch Panel Port Number
        10) Switch Port Number
        11) Any other relevant information, as requested by the Owner

    c. Manufacturers Instruction Manuals: Specification sheets, operation manuals, and service sheets published by the manufacturers of the components, devices, and equipment provided.
    d. Information for testing, repair, troubleshooting, assembly, disassembly, and recommended maintenance intervals.
    e. Replacement parts list with current prices. Include a list of recommended spare parts, tools, and instruments for testing and maintenance purposes.
    f. Performance, Test, and Adjustment Data: Comprehensive documentation of performance verification according to parameters specified herein.
    g. Warranties: Provide an executed copy of the Warranty Agreement and copies of all manufacturers' Warranty Registration papers as described herein.

h. Sufficient information (detailed schematics of subsystems, assemblies, and subassemblies to component level) clearly presented shall be included to determine compliance with drawings and specifications.
i. Any other items defined herein.

4. Local Reference Diagrams: Within each equipment rack, enclosure, or cabinet, Contractor shall place a functional diagram of the system(s) in a clear plastic sleeve secured to the equipment rack, cabinet, or enclosure.
5. Intellectual Property: Provide all required items and written release as described herein.
6. Training Program: Proposed training materials and program outline.
7. Spare Parts and Remote Controls: The Contractor shall submit a record of the Owner's sign-off of the turnover of spare parts and remote controls.

1.18 PROJECT MANAGEMENT

A. Project Manager: The Contractor shall appoint a Project Manager who will be the main point of contact for the Owner and Consultant regarding the project.

B. Responsibility: Project Manager is responsible for the following:

1. Successfully completing the contract in a timely manner.
2. Overseeing work and performance of all employees and Subcontractors who have been hired by Contractor and ensuring compliance with the specification.
3. Completing and submitting required documentation.
4. Attending project coordination meetings as required by the Owner, Consultant, and Contractor. Contractor is responsible for taking minutes of these meetings and distributing copies to all participants in a timely manner.
5. Coordinating with the Owner, Consultant, Architect, General Contractor, and other Contractors involved in the project to ensure a smooth flow of work and on-time project completion.
6. Providing a written weekly progress update to the Owner and Consultant in a PDF format emailed to the project team.
7. Reporting all unexpected conditions and problems that may result in delay or expense to the Owner and Consultant immediately upon discovery.

C. Change of Project Manager: If Contractor seeks to change the Project Manager during the course of the Project, such change is subject to prior written approval from the Owner.

D. The Owner reserves the right to request a change of project manager at any time for any reason.

1.19 EXAMINATION OF EXISTING CONDITIONS

A. Examination: Contractor shall examine the facility and construction documents to the extent necessary to plan for efficient installation strategies prior to the delivery of materials to the site or the commencement of work. Other documents (Architectural Drawings, hardware schedules, etc.) may be made available upon request. Failure to adequately complete the examination shall not result in change order requests.

B. Acceptance of Conditions: Commencement of work by Contractor shall indicate acceptance of existing conditions unless a written notice of exceptions has been provided to Owner prior to commencement.

C. Observation: If Contractor observes—during preliminary examinations or subsequent work—existing violations of fire stopping, electrical wiring, grounding, or other safety- or code-related issues, Contractor shall report these to the Owner in a timely manner.

D. Pre-Existing Damage: If Contractor observes damage to finished surfaces before they begin installation in any area, The Contractor shall document by taking digital photos of the damaged area(s) and immediately notify the Construction Manager and Consultant via email with attached photos.

E. Damage during Installation: Any damage caused by, or reasonably believed by the Construction Manager to be caused by the Contractor shall result in back-charges for said damages. Repairs shall match the preexisting color and finish of walls, floors, and ceilings. Any Contractor damaged ceiling tiles, floor, and carpet shall be replaced to match color, size, style, and texture.

1.20 CONTRACT MODIFICATION PROCEDURES

A. Changes: Changes to the contract may be initiated by the Owner, Consultant, or Contractor.

B. Request for Information (RFI): If a change originates with Contractor, the Contractor shall submit an RFI for Consultant review. If it is deemed a change is necessary, the Consultant shall issue a PR to address the change.

C. Proposal Request (PR): If a change originates with the Owner or Consultant, the Consultant shall issue a Proposal Request to Contractor.

D. Change Proposal (CP): If a change originates with Contractor or if the Contractor receives a Proposal Request from the Consultant, Contractor shall submit a Change Proposal to the Consultant to review.

1. References: A Change Proposal shall reference the work to be performed and shall include the cost change to the Project (if any) and the time change to the scheduled completion (if any).
2. Additional Information: Consultant may request additional information to be supplied with the Change Proposal for consideration.
3. Acceptance: The owner reserves the right to accept or reject Change Proposals.

E. Change Order: A Change Order is a modification of the contract.

1. If a Change Proposal is approved, the Owner will issue a Change Order that references PR and/or CP. Change Order is not valid until it has been signed by the Owner.
2. Work performed or equipment supplied outside of the contract without a valid Change Order is done at Contractor’s own risk.

1.21 PRODUCT STORAGE AND HANDLING REQUIREMENTS

A. Storage: Contractor shall provide secure material storage. If The Contractor chooses to store cabling or equipment at the project site, Contractor shall receive written approval from GC or Owner to identify an acceptable location. All equipment provided by Contractor remains the responsibility of Contractor until the Owner has beneficial use of the equipment.

B. Protection: Contractor shall take all necessary precautions to protect materials from the following:

1. Theft
2. Vandalism/Tampering
3. Dents
4. Scratches
5. Dust
6. Temperature
7. Weather
8. Cutting
9. Paint
10. Other hazardous conditions

C. Replacement: Contractor shall replace any damaged or lost material as required by the Owner or Consultant.

D. Installed Materials: Installed materials remain the responsibility of Contractor until Acceptance. The Contractor shall take necessary precautions to ensure the safety and security of installed materials.

1.22 INTERFERENCE WITH THE FACILITY

A. Transportation and storage of materials at the facility, work involving the facility, and other matters affecting the habitual use by the Owner of the Owner's buildings shall be conducted to minimize interference, and at times and in a manner acceptable to the Owner.

1.23 ON-SITE CONDUCT

A. Conduct: Any demonstration of rudeness, use of profanity, or lack of respect by Contractor Personnel to a building tenant will be cause for immediate removal from the premises, and such Personnel will not be allowed to return. Contractor and Contractor's Personnel are to remain in the project area.

B. Vandalism: Graffiti or vandalism will not be tolerated. Any Contractor/Personnel caught in the act shall be immediately removed from the premises and will not be allowed to return.

C. Hazardous Conditions: No one shall be allowed to endanger the building, its premises, or its occupants in any manner whatsoever. In the event that a situation occurs which threatens the building or its occupants in any manner, Contractor, Contractor Personnel, Sub Contractor, etc., shall take immediate steps to correct the hazardous condition. In the event that Contractor's

Personnel fail to correct hazardous conditions, the Owner reserves the right to immediately take steps to correct the situation at Contractor's expense.

1.24 SAFEGUARDS AND PROTECTION

A. Barriers: Provide and maintain suitable barriers, guards, fences, and signs wherever necessary to accommodate the safety of others relative to and/or for the protection of this work.

B. Regulations: Comply with OSHA, Federal, State, Local, and Owner regulations and standards pursuant to this work.

C. Protection: Protect all materials and equipment to prevent the entry or adhesion of any and all foreign material. If necessary, cover equipment with temporary protective material suitable for this purpose.

D. Finishing: Check, clean, and remove defects, scratches, fingerprints, and smudges, if necessary, from all equipment and devices immediately prior to Acceptance of the Installation.

E. Damage: Replace all damaged or defective material or work at no additional cost prior to Final Acceptance.

F. Documentation: Provide a written description of accidents by workers, staff, and the general public of any incident occurring on the project. Report the incident in writing to the Owner's representative immediately and to the Project Manager for follow-up.

1.25 OWNER-FURNISHED PRODUCTS

A. Delivery: Owner is responsible for the delivery of Owner-furnished products to the project site unless otherwise specified in this document.

B. Placement: Contractor is responsible for locating, inspecting, and moving Owner-furnished products to their final installation position.

C. Inspection: Contractor shall report any damage or discrepancies in quantity, type, or function to the Owner and Consultant immediately upon discovery.

D. Warranty: Contractor assumes no responsibility for any material warranty for Owner-furnished products. Contractor shall be responsible for integrating, cabling, and installing Owner-furnished products under the same warranty conditions as other products furnished by Contractor.

1.26 QUALITY ASSURANCE

A. Assurance: It is the intent of these specifications to describe and provide for a complete, professional, and reliable installation.

B. Qualifications: Contractor employees who are engaged in the installation shall be adequately trained in the tasks they are expected to perform.

C. Acceptability: Owner shall determine the acceptability of work.

D. Regulatory Requirements: Contractor shall comply with code requirements that apply to the work being performed.

E. Certifications: Where manufacturer certifications are required for warranty or for authorized resale, installation personnel shall have received such certification prior to the start of installation of those manufacturers' materials.

1.27 QUALITY CONTROL

A. Installation: During the installation period, when connections are made to the Owner's existing infrastructure, Contractor shall use care to ensure that such connections will not have a negative impact which could reduce or hamper existing systems.

1.28 OWNER'S RIGHT TO USE EQUIPMENT

A. The Owner reserves the right to use equipment, material, and services provided as part of this work prior to Acceptance of the Work, without incurring additional charges and without commencement of the Warranty period.

1.29 INTELLECTUAL PROPERTY OWNERSHIP

A. All intellectual property shall remain in escrow for an unlimited period of time. All supporting documentation, including but not limited to software, firmware, programming, uncompiled source code, graphic files, diagrams, written and electronic files, including all latest versions of the documentation and software necessary to edit and adapt the system(s), shall be provided to the Owner on a CD or DVD for all spaces and all systems. The integrator and/or programmer shall also maintain a current live copy incorporating all system modifications to be provided at the Owner's request and for system restoration upon a failure.

B. A written release shall be given by Contractor and all other required parties for all programming and configuration done by Contractor and/or Subcontractors. This release will acknowledge the Owner's ownership and right to modify the intellectual property directly or to have the intellectual property modified by any party of the Owner's choosing.

PART 2 - PRODUCTS

2.1 BASIC EQUIPMENT AND MATERIALS REQUIREMENTS

A. Standards: Equipment and materials used to accomplish the goals of this project shall meet standards for good engineering practice as defined within this document.

B. Quality: Products specified in these documents are intended to establish a baseline or operational, functional, and performance-based standards that all proposed products shall meet or exceed by functionality and quality.

2.2 FACTORY-ASSEMBLED PRODUCTS

A. Manufacturer: Reference to specific equipment manufacturers does not imply that all products produced by that manufacturer meet the specification requirements.

B. Age of Equipment: Equipment shall be new and unused with full manufacturer's warranties. Contractor shall supplement such warranties as required by the specification. Contractor shall immediately notify the Consultant of any product that will be or is expected to be discontinued by the end of the project for resolution.

C. No Modification: Where a product is available from a factory/manufacturer to meet the needs as outlined, that product shall be used without modification to ensure the full factory warranty is maintained.

D. Like Materials: Like materials used shall be of the same manufacturer, model, and quality unless otherwise specified.

E. Software/Firmware: No software or firmware is to be used unless specifically authorized by the Owner or its appointed representative.

2.3 RACKS, CABINETS, HARDWARE

A. Equipment Racks and Cabinets: Provide racks and cabinets as specified herein and/or described in accompanying documents, appendices, or drawings. Verify that any existing racks and/or cabinets provided by others are complete, bringing any discrepancies to the attention of the Owner and Consultant prior to beginning the installation.

B. Shelves and Mounts: Contractor shall supply the necessary mounting hardware to install rack-mounted equipment. Mounting hardware shall be a product of the manufacturer of the equipment to be mounted or the manufacturer of the rack system or approved by either for use with their product. Provide supporting channels, shelves, rack mounts, and/or rack ears as recommended by equipment manufacturers.

C. Screws and Washers: Contractor shall provide screw head types appropriate to the level of security required for the equipment and racking. Screws shall include polyethylene or nylon washer.

1. Public Access Areas: Star post or square post security screws shall be used for hardware and equipment mounted in equipment racks and consoles in areas that are accessible to the public.
2. Restricted Access Areas: Philips head screws may be used where a secure room entrance or locked rack/console door prevents public access.

2.4 POWER DEVICES

A. Power Strips: Unless otherwise specified, power strips shall be UL-listed, surface mounted, and rated for 20 amp continuous electronic loads. Outlets shall be 125 volts, 20 amp, three-wire, grounded, and NEMA 5-20R compliant. Cords shall be 12/3 SJT with molded plugs.

B. Power Distribution Panels: Unless otherwise specified, power distribution panels shall be UL listed, rack-mounted, rated for 20 amp continuous electronic loads, with switch and pilot light. Up to eight outlets shall be mounted to the back; each rated 125 volts, 20 amp, three-wire, grounded, and NEMA 5-20R compliant. Switch and pilot shall be mounted to the front. Cords shall be 12/3 SJT with molded plugs.

C. Contractor shall provide acceptable power distribution units as required in order to provide sufficient outlet connectivity for Contractor-furnished and Owner-furnished equipment indicated on drawings and equipment schedules, plus up to 15% additional capacity for future growth. This may be in addition to any power distribution equipment indicated on equipment schedules.

2.5 CABLE AND CONNECTORS

A. Cable: Cable shall be selected and applied in a manner defined by signal type, consistent with best industry practices. Highest quality products shall be used with attention given to transmission characteristics, termination methods, resistive and complex impedance at operating frequencies, and insulating material characteristics. Where required by the NEC, substitutions of air-handling plenum cable shall exactly match the normally applied product and shall meet the standards of UL Standard #900 and NEC Articles 800 and 820.

B. Connectors: Highest quality products shall be used with attention given to transmission characteristics, termination methods, resistive and complex impedance at operating frequencies, and insulating material characteristics. Strain reliefs and cable clamps shall be sized for the connector and the cable.

C. Color: Cable and connector color shall be coordinated with the Consultant to maintain consistency with cable and connector color schemes used by other trades.

2.6 CABLE MANAGEMENT

A. Plastic Cable Ties: Single-use white nylon plastic cable ties, appropriate screw fittings, or mounting clips may be used for AC power cable management within racks and enclosures. Plastic/nylon cable ties shall not be used for signal and DC cables.

B. Velcro Cable Ties: Velcro straps shall be used for all signal and DC cables. Velcro straps shall be black, with no logo or decoration, except as authorized by the Consultant.

2.7 ANCILLARY HARDWARE

A. General: Contractor shall provide ancillary and required accessory items necessary to provide a complete and fully functional system to the Owner.

B. Interpretation: Exclusion of or limitation in the language used in the drawings or specifications shall not be interpreted as meaning that ancillary or accessory items of work or equipment necessary to complete or make the installed system fully functional can be omitted.

2.8 GROUNDING HARDWARE

A. Refer to Section 270526 for specific Grounding and Bonding requirements.

B. Provide data/telecommunication grounding systems indicated in the project drawings and specifications. Products shall include but are not limited to cables/wires, connectors, terminals, compression lugs, grounding rods/electrodes, plate electrodes, bonding jumper braid, surge arresters, and additional accessories needed for a complete installation. Where materials or components are not indicated, provide products complying with NEC, UL, IEEE, ANSI/TIA, and established industry standards for applications indicated.

2.9 COMPATIBILITY OF RELATED EQUIPMENT

A. Existing Equipment: Equipment and systems specified in these documents shall be assumed to be compatible with the systems already installed at the Owner site(s) and as identified in this document as related to this project.

B. Installed Equipment: Specified equipment and systems shall be compatible with all other equipment and systems as offered by Contractor, thus placing the responsibility on Contractor to ensure proper interaction.

2.10 LICENSES

A. Any and all licenses required for system functionality shall be provided.

2.11 SPARE PARTS

A. Suggested List: Contractor is requested to submit a list of suggested spare parts with an offered price, allowing the Owner to select appropriate parts.

B. Means of Obtainment: Contractor shall state where spare parts can be obtained after the installation.

2.12 MAINTENANCE MANUALS

A. Contractor shall produce a maintenance manual showing the interconnection of equipment and any special procedures necessary for the proper operation and maintenance of the systems.

PART 3 - EXECUTION

3.1 GENERAL

A. Contractor shall provide, furnish, deliver, transport, erect, install, connect, and configure all of the material and equipment described herein or depicted on any bid package document or drawing, as required for a turnkey solution.

3.2 COORDINATION

A. General: Contractor shall cooperate with other Contractors for proper provisioning, anchorage, placement, and execution of all work. Interference between the work of various Contractors shall be resolved before installation. In the event of a conflict on space requirements or location of devices, refer the matter to the Owner and Consultant for decision.

B. Related Work: References to the following related work do not limit or release The Contractor from the responsibility of coordination with other trades or from having the necessary knowledge of other non-referenced work.

1. Work by General Contractor.
2. Work by other Technology Contractors.
3. Work by Electrical Contractor, including electrical rough-ins and surface-mounted raceway.

C. Delays: Contractor shall coordinate with all other trades to avoid causing delays in the installation schedule.

D. AC Power: Contractor shall coordinate with General Contractor its requirements for proper AC power to service all equipment installed by Contractor.

E. Low Voltage Sleeving: Contractor shall provide openings through walls as necessary, with sleeving and fire-stopping materials installed in a professional manner to meet local and national codes.

F. Grounding and Bonding: Contractor shall coordinate with General Contractor its requirements for proper grounding and bonding to their equipment.

G. Surface-Mounted Raceway Coordination

1. General and Electrical Contractors: Contractor shall coordinate with the General Contractor and Electrical Contractor the installation of surface-mounted-raceway where not provided but made necessary by a non-penetrable wall.
2. Verification: Contractor shall field verify and coordinate the proposed use of a surface-mounted raceway at any location with the Consultant and Owner.

3.3 BASIC EXECUTION REQUIREMENTS

A. General: Contractor is responsible for following industry standards of good practice for telecommunications and networking equipment.

B. Aesthetic Factors: With the installation of equipment and cables, consideration shall be given not only to operational efficiency but also to overall aesthetic factors. Contractor shall redo, at no cost to the Owner, any work deemed by the Owner to appear sloppy, hastily done, or unprofessional. Owner shall make the final decision over whether the work shall be redone.

C. Manufacturer's Recommendations: Manufactured items, materials, and equipment shall be applied, installed, connected, erected, used, and adjusted as recommended by the manufacturers or as indicated in their published literature unless otherwise noted herein.

D. Protection of Work Area: Work shall be properly protected during construction, including shielding soft or fragile materials, protecting against dust and dirt, protecting and supporting cable ends off of the floor and from other traffic, protecting floor box lids, and temporarily plugging open conduits during construction. Upon completion, installation shall be thoroughly cleaned, and all tools, equipment, obstructions, or debris present as a result of work shall be removed from the premises.

E. Protection of Cable and Equipment: Contractor shall make appropriate preparations to protect all cabling and equipment from foreign material. Foreign material is defined as any substance or material that would void the manufacturer’s performance warranty, impact ratings (UL, Plenum, etc.), or cover-up markings needed for inspection. Foreign material includes but is not limited to paint overspray (intentional or not), fire-stopping material, drywall compound, or any other chemical, liquid, or compound that could come in contact with cables, cable jackets, cable termination points, or other equipment.

1. Cleaning of cables or equipment with harsh chemicals from a failure to comply with the Protection of Cable and Equipment clause is unacceptable. Contractor shall replace any affected cable, cable components, or equipment in their entirety at Contractor’s sole cost.

F. Waste Materials: Contractor shall keep work area neat, orderly, and free from accumulation of waste materials. Remove trash and debris from the building and job site as required to maintain a clean work environment at all times. Rubbish shall be moved to a common trash point or receptacle on the job site as determined and directed by General Contractor or Owner.

G. Dumpsters: No construction debris shall be placed in the building’s dumpsters. Contractor shall provide a dumpster for construction waste and debris at their own expense. Said dumpster shall be emptied on a regular schedule. Location of the dumpster shall be arranged through Building Management. Appropriate measures shall be taken to protect asphalt or other ground surfaces.

H. Ceiling Grid: Contractor shall not hang cable supports from ceiling grid wire.

I. Roof Deck: Contractor shall not shoot into the roof deck to mount cable hangers.

J. Mounting: Equipment and enclosures shall be mounted plumb and square in relation to the structure.

K. Raised Floor: All cabling installed below the raised floor shall be placed in the provided cable trays with appropriate means to hold the cable in place. If no cable tray exists, Contractor shall provide J-hooks to hold cables in place. Sleeves shall be utilized for cable egress.

L. Motorized Furniture: Care shall be taken to properly dress all cables placed within motorized furniture and provide sufficient cable length and strain relief to allow motorized elements to operate within their full range of travel.

M. Flexible Furniture: Care shall be taken to properly dress all cables placed within flexible or re-configurable furniture to provide sufficient cable length and strain relief to allow a full range of travel for flexible furniture configurations.

3.4 PREPARATION

A. Existing Equipment: Prior to any installation, Contractor shall prepare the site by removing any remaining debris, leveling equipment racks (where appropriate), and verifying information and systems stated to be in place are ready for use.

B. Equipment for Installation: Prior to installation, Contractor shall ensure that the required major equipment has been secured and is ready for installation.

3.5 CLEANING

A. Tool Clean-up: Contractor is not permitted to use restrooms for tool clean-up. A slop sink may be provided in the janitorial closet on each floor for the cleaning of tools and equipment and as a source of water. The janitorial closet, maintenance area, or shop shall be kept clean at all times. Contractor or Contractor's personnel found using restrooms for clean-up or other similar purposes shall be subject to removal from the building.

B. Daily: At the end of each work period or day, Contractor shall remove excess packing, drilling remnants, and other non-equipment-related parts, materials, or debris to ensure a clean, safe, and professional working environment.

C. Carpet: Contractor shall ensure that no damage to carpeting occurs as a result of their work. Contractor shall cover carpets in areas of work to prevent wire and other debris from entering the carpet.

3.6 DEMOLITION

A. Scope of work:

1. Demolition of all category cables in the building from device to source.
2. Take down existing MDF and IDF equipment, racks, cabinets, and UPS, and deliver to the technology warehouse.
3. Take down all existing cameras, encoders, DVR's and NVR's and deliver them to the maintenance warehouse. Demolish the cabling.

4. Take down all existing PA equipment speakers, headend, and racks, and deliver them to the maintenance warehouse. Demolish the cabling.
5. Take down existing intrusion panels, motions, glass breakers, keypads, and horns and deliver them to the maintenance warehouse. Demolish the cabling.
6. Take down existing wireless access points and deliver them to the technology warehouse.

B. General: Contractor shall be responsible for the removal, collection, transportation, and recycling of all cabling and components that become abandoned as a result of this project. This shall include the delivery of cable and components to the proper recycling centers. If material is to remain on site for more than seven days after removal, Contractor shall coordinate with Owner for an acceptable storage location.

C. Verification: Contractor shall field-verify existing conditions prior to beginning demolition work. Any discrepancies shall be reported to the Consultant prior to the start of work in order to prevent disturbance of existing installation(s). Beginning work shall indicate acceptance of existing conditions. Contractor is responsible for immediately restoring any outages caused as a result of removing or damaging adjacent cabling, systems, or services.

D. Abandoned Cable: Contractor shall remove all abandoned cables back to the headend. Where it is not possible to remove cables without damaging other cables that are to remain, such as in a shared conduit, Contractor shall report these conditions to the Consultant for approval. These cables shall be cut at entry and exit points, leaving a minimum of 24” of cable at each end.

E. Cover Plates: Contractor shall provide and install blank cover plates for any outlets or junction boxes that are to be left in place and from which all cables have been removed. Cover plates shall match the Project standard color and finish.

F. Equipment: Contractor shall remove all equipment abandoned as part of this project. Contractor shall be responsible for the delivery of this equipment to a proper recycling facility. Any electrical service connected to the equipment shall be properly decommissioned and labeled to prevent any safety issues.

G. Right of Refusal: The Owner shall have first right of refusal to any abandoned cable or equipment. The Owner has the right to remove any components from the equipment before it is recycled.

3.7 FIRE STOPPING

A. Contractor is responsible for applying fire-stopping material in and around all openings that it creates or is created for it, whether or not specifically indicated in specifications or project drawings where code requires the use of fire-stopping material.

B. Contractor shall ensure that all fire-stopping materials meet appropriate codes and are installed in a neat and workmanlike manner.

3.8 WATERPROOFING

A. Contractor is responsible for creating a waterproof seal in and around any openings to the outside environment that are created by Contractor or for systems being installed.

B. Contractor shall ensure that all waterproof materials meet appropriate codes and are applied according to good engineering practice.

3.9 RACKS, CABINETS, AND HARDWARE

A. Racks and Cabinets: Contractor shall assemble and install racks and cabinets.

B. Installation Hardware: Install hardware in a secure manner. Screws shall be tightened to torque, just sufficient to secure equipment without deforming washers beyond their original diameter.

C. Considerations: Rack mount equipment shall be secured as recommended by the manufacturer with consideration to airflow, power, and in/out connections.

D. Cross Connections: Where cross connections are required between equipment, interconnections shall be installed using cable management devices to secure cables in a neat and workmanlike manner, applying best industry practices.

3.10 INSTALLATION REQUIREMENTS

A. Cable pulling shall be done in accordance with the cable manufacturer's recommendations and ANSI/IEEE C2 standards. Recommended pulling tensions and pulling bending radius shall not be exceeded. Any cable bent or kinked to a radius less than recommended dimension shall not be installed.

B. All cables shall be pulled by hand unless installation conditions require mechanical assistance. Where mechanical assistance is used, care shall be taken to ensure that the maximum tensile load for the cable, as defined by the manufacturer, is not exceeded. This may be in the form of continuous monitoring of pulling tension, use of a "break-away," or other approved method.

C. Qualified personnel utilizing state-of-the-art equipment and techniques shall complete all installation work. During the pulling operation, an adequate number of workers shall be present to allow cable observation at all points of pathway entry and exit.

D. All cables shall be free of tension at both ends.

E. PLENUM-rated cable shall be used in areas used for air handling or where required by code.

F. Contractor shall replace any cables that have been damaged or abraded during installation.

G. Pulling lubricant may be used to ease pulling tensions. Lubricant shall be of a type that is non-injurious to the cable jacket and other materials used and will not harden or become adhesive with age.

H. A pull cord (nylon; 1/8" minimum) shall be co-installed with all cables installed in any conduit or surface mount raceway.

3.11 CABLE

A. Cable treatment: Cable shall be stored and handled to ensure that it is not stretched, kinked, crushed, or abraded in any way. Bend radiuses shall meet manufacturer specifications and/or recommendations. Cable shall not be installed in ambient temperatures or moisture conditions above or below the rating of the manufacturer.

B. Contractor is responsible to provide the district with first right to refusal to any leftover cabling boxes. Its in the district expectation to receive the left over boxes of cables after each project.

C. Splicing

1. Voice, data, and other twisted pair cables: No splices shall be installed in any voice, data, or twisted pair cables.
2. Technology systems: No splices shall be installed in any cable less than five hundred (500) feet in length.
3. Digital multimedia/video cables: No splices are allowed in any digital multimedia/video cable.
4. Overhead paging systems: Cable splices for constant voltage overhead paging system shall occur only at speaker, amplifier, or volume control knob locations.

D. Lengths

1. Variations: Where cables are to be of the same length, variations in the length shall be less than plus or minus ½ inch. Lengths of cables are based on the length of the unterminated signal conductors.
2. Labeling: Cables, regardless of length, shall be marked with a labeling scheme approved by the Consultant.
3. Service Loops: A surplus of cable located at or near the point of termination to facilitate potential future changes shall be provided where appropriate. Cables shall have a minimum cable slack of 10ft (3m) at the telecommunication room(s) and 3.28ft (1m) at each telecommunications outlet in the suspended ceiling unless noted otherwise. Service loops shall be stored in an extended loop or in a figure-eight configuration, not in bundled loops.

E. Grouping

1. Cables shall be separated into like groups according to signal or power levels.
2. Power Cable Group: Power cables shall be secured to one side of the rack, separate from any low-energy signal cable groups. Separation shall be a minimum of 4” in all directions.
3. Signal Cable Group: Signal cables shall be grouped according to signal type and secured to one side of the rack, separate from any power cable groups. Separation shall be a minimum of 4” in all directions.

F. In Equipment Racks

1. Equipment rack wiring and cabling shall be neatly dressed.
2. Fastening: Rack cabling shall be adequately supported with Velcro wire wraps and horizontal support cable managers fastened to the rack frame.

G. Support for Cables Outside of Equipment Racks

1. External wire and cables shall be supported at least every 5 feet (1.5m) from the structure and as required to maintain less than 12 inches of cable sag between supports without over-tensioning the cables. Contractor shall vary the precise distance between cable supports on long runs to avoid harmonics issues.
2. Hardware: Cables shall be supported by J-hooks, cable trays, or ladder racks. Hardware shall be secured to the building structure using 3/8" threaded rod supports.

    a. Right Angles: Cables are to run at right angles to the structure, placed above the ceiling in halls or corridors.
    b. Height: Cables shall not run above the red iron joist.

H. Concealment: Contractor shall make every effort to conceal wiring and other apparatus into walls, floors, and ceilings, assuming code and good engineering practice allow and suggest. Cabling systems installed in public areas shall be installed within walls, ceilings, or floors or within surface wiring pathways, as dictated by codes and good engineering practice.

I. Velcro Straps for Horizontal Cabling: Straps shall be installed snugly without deforming cable insulation. Straps shall be spaced at uneven intervals, not to exceed 4 feet.

J. Cable Ties and Velcro Straps within Equipment Racks and Cabinets: Ties and straps shall be installed snugly, without deforming cable insulation, at uneven intervals not to exceed 8 inches. Cable ties shall only be used for non-signal carrying cables. No sharp burrs shall remain where the excess length of the cable tie has been cut.

K. Obstruction: Contractor shall notify the Owner immediately if any obstruction or hazard is discovered in a pathway provided by others.

3.12 CONNECTORS

A. Preparation: Cables shall be carefully prepared and connectors installed as directed by the manufacturer. Proper stripping devices and crimping tools shall be used.

B. Terminations: Connectors shall be carefully fitted to mating devices on equipment to avoid damage to mating contacts, inserts, or bodies. Specialized terminations shall be made in a neat and secure manner suited to the service of the wire and as directed by the manufacturer. Contractor shall use manufacturer specified terminations when those specifications exist.

C. Soldering: A person skilled in that practice shall execute soldered terminations. Any excessive insulation displacement resulting from soldering shall be grounds to require Contractor to re-terminate the connector.

D. Adapters: Adapters shall be used only where the identity of the necessary type of connector is unknown at the time of installation, such as for Owner-provided equipment or in anticipation of future equipment upgrades, with the Consultant's approval.

3.13 SPARE PARTS AND REMOTE CONTROLS

A. Keys: Contractor shall turnover all keys, tagged and organized by type on individual key rings, to the Owner upon project completion.

B. Refer to individual sections for spare parts and remote control requirements.

3.14 EQUIPMENT INSTALLATION

A. General: Contractor shall make the system properly operational and physically secure by mounting equipment and related accessories into furniture, consoles, and racks as required. Manufacturer's guidelines for installation shall be followed. Discrepancies in installation procedure or inability to complete a given task due to a shortage of materials or malfunctioning equipment shall be reported to the Consultant immediately upon discovery.

B. Equipment Placement: Contractor shall locate equipment as indicated on drawings and as specified herein. Where such information is not provided, Contractor shall follow industry best practices and locate operable devices at convenient positions, heat-generating devices at the top, and seldom-accessed equipment below.

1. Unless otherwise specified, end user-operable devices shall be positioned within the range of front wheelchair access per ADA standards.

C. Equipment Installation: Equipment shall be installed as directed by the manufacturer using the equipment manufacturer's desktop mounting frames, equipment tubs, installation hardware, and techniques. Contractor shall be responsible for moving equipment from storage and for providing necessary personnel or devices to carry and lift equipment around obstacles and into operating position.

3.15 SOFTWARE AND FIRMWARE

A. At the completion of the project, the Owner shall have the option to receive final software updates and firmware updates to the latest versions before the project is paid in full at no cost to the Owner.

3.16 ROUGH-IN

A. Scheduling: Contractor shall make every effort to install systems per this specification in a timely manner, including rough-in of cabling and other apparatus where appropriate to stay on schedule.

B. Protection of Environment: Where cabling and/or equipment is installed prior to other trades completing their work in an area, Contractor shall take necessary precautions to cover, wrap, or otherwise protect to reduce possible damage which may result from plastering, painting, cleaning, or other such work completed after installation and before substantial completion of the project.

3.17 CUTTING, DRILLING, PATCHING, AND PAINTING

A. Coordination: Contractor is responsible for coordinating with the General Contractor and other trades when any cutting or drilling is required for the installation or proper performance of the specified systems.

B. Restoration: Contractor is responsible for returning all surfaces (including walls, floors, and ceilings) to their previous condition after any cutting, including painting.

C. Painting: The Contractor is responsible for painting all new work, including the exposed pathways, to match the conditions.

3.18 LABELING

A. General: Rack-mounted equipment and hardware shall be labeled as required herein. Connectors, jacks, receptacles, outlets, cables, cable terminations, terminal blocks, rack-mounted equipment, active slots of card frame systems, etc., shall be clearly, logically, and permanently labeled in a manner acceptable to the Consultant.

B. Approval: Proposed wording and/or numbering schemes for labeling shall be provided to the Consultant for review and written approval prior to procurement or installation.

C. Labels used shall be permanent and secure. Provide labeling as follows unless otherwise noted in a specific section:

1. Like Size: All labels, including engraved labels, shall be sized to match other labels used for the same purpose.
2. Equipment Racks: For enclosed racks containing equipment, provide labels on each equipment rack rear door or console rear panel reading “No user-serviceable parts. Refer service to a qualified technician.”
3. Installer and Consultant Identification: Position at the front top center section of each equipment rack a label that states the names of the system, Installer, and Consultant.
4. Custom Panels: Custom panel nomenclature shall be engraved, etched, or screened. Markings are to be designed to ensure consistency and clarity within and without of system. Verify markings and placements by submitting label sample layouts to the Consultant for approval prior to procurement.
5. Documentation: Labeling information shall appear on the as-built drawings.

3.19 FIRE-STOPPING

A. If Contractor removes anything from an opening in a fire-rated wall, Contractor shall restore the fire-rating condition of the wall to the same condition as before Contractor started its work. Depending on the size of the opening, this may involve sheetrock patching, in addition to the use of other appropriate fire-stopping materials.

3.20 ADDITIONAL ENGINEERING SERVICES

A. General: Contractor is responsible for securing necessary engineering services wherever needed to meet the needs of the installation.

B. Change Orders: Only when Contractor can show that additional engineering services are needed as a result of changes to the scope of the services being requested in the contract documents will Owner entertain a Change Order Request for these services.

3.21 TESTING

A. Procedure: Contractor shall develop a rigorous testing procedure to ensure full functionality and durability of installed systems under heavy-use conditions.

B. Supplies: Contractor shall supply testing equipment needed to verify compliance with the specifications found in these documents.

C. Schedule: Contractor shall complete the required testing prior to the substantial completion inspection by the Owner and Consultant.

D. Data: Test data shall be properly documented and recorded so that it is available for the final inspection.

E. Quality Control: Testing may be repeated during the inspection process at the request of the Owner or Consultant.

F. Prior to energizing or testing the system, Contractor shall ensure the following:

1. Installation: Products are installed in a proper and safe manner per the manufacturer’s instructions.
2. Cleanliness: Products are neat, clean, and unmarred, and parts are securely attached. Dust, debris, solder, splatter, etc., is removed.
3. Cables and Connections: Cable is dressed, routed, and labeled; connections are consistent with regard to polarity.
4. Grounding: Electronic devices are properly grounded.
5. AC Power: Each AC power receptacle is tested with a circuit checker for proper hot, neutral, and ground connections prior to connecting equipment.

3.22 GROUNDING

A. Refer to Section 270526 for specific Grounding and Bonding installation requirements.

3.23 TRAINING PROGRAM

A. Contractor shall provide training in the manner delineated below in addition to specific requirements identified in subsequent sections.

B. Contractor shall provide an audio-video recording of each training session to the Owner.

C. Prior to scheduling or delivering End User training, Contractor shall confirm that the:

1. Closeout submittals have been accepted by the Owner and Consultant.
2. Final closeout inspection has been completed, and punch list items have been rectified.
3. Training schedule dates have been coordinated with and approved by Owner and Consultant.

D. Training shall include:

1. Approved handouts.
2. Practical and comprehensive operation of systems.
3. Basic system troubleshooting techniques.
4. Basic system maintenance.

E. Training Blocks

1. Training time is defined as those hours specifically set aside for the sole purpose of training end users. Credited time will not be given for any time spent providing instructions to the Owner's staff for a system not completed, or that has not passed final acceptance by the Owner and Consultant, or training performed outside of the approved training program.
2. This training will be divided into training sessions, "Blocks," as coordinated with the Owner.

    a. The first training session block shall consist of training intended for the common system operators. Such training, at a minimum, shall include the day-to-day use of the system.
    b. The second training session block shall consist of training administrators on the day-to-day administration of the system. Such training, at a minimum, shall include the use of the administration control functions of the systems, user setup, and filtering and pulling reports.
    c. The third training session block shall consist of training administrators on system troubleshooting, maintenance, and updates. Such training, at a minimum, shall include using the system tools to diagnose issues, diagnosing common physical equipment issues, performing simple maintenance, and performing system updates.
    d. The fourth training session block shall consist of a training session structured for high-level users, for example, staff trainers who will provide instruction to other users and will include advanced system configuration and operational knowledge needed to maintain and manage all specified technology systems. Contractor may elect to engage the Manufacturer(s) in certifying the high-level end users in the systems at no cost to the Owner.

F. Contractor shall issue a certificate of training completion to the trainees upon completion of their training. Such certificates must be signed by both the trainer and trainee(s) for Contractor to receive training credit.

3.24 WARRANTY AND MAINTENANCE PROGRAM

A. Contractor shall provide a warranty conforming to the stipulations below in addition to specific requirements identified in subsequent sections.

B. As part of the base proposal cost, Contractor shall include a 1-year turnkey warranty period with full support costs.

1. Pricing for warranty services to be provided in years two through five shall be itemized on the Contract's Unit Pricing Form as part of a complete response. The Owner may fund the additional warranty services separately or not at all at the Owner's discretion.

C. The Warranty period shall begin after all punch list items have been rectified. Contractor shall receive a letter of completion from the Consultant and Owner indicating project completion and starting the warranty period.

D. The warranty and support work included in this contract shall cover the following materials, software, and services without additional cost to the Owner:

1. Inspections, preventative maintenance, and testing of equipment and components. Contractor shall schedule a 10-month on-site preventative system review 10 months into each year of warranty and support, including system inspections, preventive maintenance, software upgrades/patches, and testing of equipment and components.
2. Regular Service, Emergency Service, and Normal Service.
3. Labor, travel, equipment, materials, and transportation cost for all services are covered by this warranty.

E. Response Time: Contractor shall respond to calls for warranty services in a timely manner, as delineated below.

1. The Owner reserves the right to make the final determination of emergency or normal service calls and the right to coordinate the best times for service of any system failure.
2. Emergency service calls are defined as failures that prohibit the use of a typical system function(s) and pose a life safety concern or such failures which cause a major impact on the Owner's daily operations.

a. Contractor shall provide remote service diagnosing the impact within two (2) hours after notification by the Owner.
b. If remote service does not correct the reported issue, Contractor shall provide on-site service correcting the impact within four (4) hours after notification by the Owner.

3. Normal service calls are defined as failures that prohibit the use of typical system function(s) but which do not inhibit critical system usage, do not pose life safety concerns, and do not create a major impact on the Owner's daily operations.

a. Contractor shall provide remote service correcting the impact within twenty-four (24) hours after notification by the Owner.

b. If remote service does not correct the reported issue, Contractor shall provide on-site service correcting the impact within forty-eight (48) hours after notification by the Owner.

4. Contractor shall supply Service Request forms and or proper contact procedure to the Owner with instructions for proper notification of Contractor for warranty service. By following said instructions, the Owner shall constitute proper notification for any needed warranty service.

F. Repair Time: Contractor shall locally stock critical parts in sufficient quantities such that emergency repair or replacement shall be guaranteed within twelve (12) hours. Temporary replacements within this time period shall be acceptable, provided temporary replacements do not compromise system functionality and provided permanent replacement is achieved within ninety-six (96) hours. Contractor may contact the Owner for the use of Owner-supplied spare parts where a delay in system repair will have a negative impact on system performance.

G. Transmittal: A copy of this Warranty shall be delivered to and signed for by the Owner's representative, whose primary responsibility is the operation and care of these systems. A copy of the signed Warranty document shall be delivered for review as part of the Final Submittals.

H. Registration: Contractor shall register Warranty papers for all equipment and software in the name of the Owner and furnish reproductions of all equipment Warranty papers to the Owner with the Final Submittals.

I. Subcontracting: Warranty service work may not be subcontracted except with specific permission and approval by the Owner.

1. Service/Warranty Procedures: Contractor shall submit a warranty service plan containing all contact information and Owner service call directions for Owner review with project close-out submittals.

J. Resolution of Conflicts:

1. The Owner retains the right to resolve unsatisfactory warranty service performance at any time by declaring the work unsatisfactory and stating specific areas of dissatisfaction in writing.
2. If Contractor or his approved Sub Contractor does not resolve such stated areas of dissatisfaction within ninety-six (96) hours, the Owner may appoint an alternative service agency or person to fulfill the terms of the Warranty at the expense of Contractor. This action may be taken repeatedly until the Owner is satisfied that the Warranty service performance is satisfactory. Satisfactory resolution of a malfunction shall be considered adequate when the device, equipment, system, or component which is chronically malfunctioning is brought into compliance with the standards of performance as contained herein and published by the manufacturers of the equipment installed.

END OF SECTION 270000

SECTION 270500- COMMUNICATIONS GENERAL REQUIREMENTS

PART 1 - GENERAL

1.1 SCOPE

A. Refer to Section 270000 for additional project scope information.

B. This section describes the products and execution requirements related to furnishing and installing Category 5e/6/6a Cabling and Termination Components and related subsystems as part of a Structured Cabling System.

C. Backbone system comprising copper and fiber optic cabling and horizontal (station) cabling is covered under this document.

D. Others will provide the network electronics for the LAN within the Telecom Rooms (TRs) and will be responsible for connecting the new cabling infrastructure to the LAN. Contractor, however, shall supply the patch cords. Contractor shall be available on-site during the crossover to assist with any cabling issues that may occur during the connection.

E. The Electrical Contractor shall install conduits and surface raceway for new technology outlet locations unless otherwise noted.

F. The Telecommunication Contractor shall provide and install all sleeves through the wall penetrations as required, whether or not specifically marked on Project Drawings, unless otherwise noted.

G. All cables and related terminations support and grounding hardware shall be furnished, installed, wired, tested, labeled, and documented by Contractor, as detailed in the following section(s).

H. All work and materials shall conform in every detail to the rules and requirements of the National Fire Protection Association, the Electrical Code in the state where the work is to be performed, and present manufacturing standards.

I. All materials shall be listed by UL and shall bear the UL label. If UL has no published standards for a particular item, then other national independent testing standards shall apply, and such items shall bear those labels. Where UL has an applicable system listing and label, the entire system shall be so labeled.

1.2 RELATED WORK

A. Section 270000 – General Technology Requirements

B. Section 270526 – Grounding and Bonding for Technology Systems

C. Section 270528 – Pathways for Technology Systems

D. Section 270537 – Firestopping for Technology Systems

E. Section 271100 – Communications Equipment Rooms

F. Section 271300 – Communications Backbone Cabling

G. Section 271500 – Communications Horizontal Cabling

H. Section 271600 – Communications Connecting Cords

I. Section 271800 – Communications Labeling and Identification

J. Section 274000 – AV/Multimedia General Requirements

K. Section 274100 – Audio Visual Systems

L. Section 275100 – Distributed Communications Systems

M. Section 276000 – Physical Security General Requirements

N. Section 276200 – Electronic Access Control System

O. Section 276400 – Video Surveillance System

P. Section 276600 – Intrusion Detection System

1.3 DEFINITIONS

A. Refer to Section 270000 for additional definitions.

1.4 REFERENCE STANDARDS AND CODES

A. Refer to Section 270000 for additional requirements.

B. All references relating to the current version adopted by the city/county according to the authority having jurisdiction (AHJ). If the city/county has not adopted a version, the latest version shall be utilized.

C. ASTM B633: Specification for Electrodeposited Coatings of Zinc on Iron and Steel

D. ASTM A653: Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process

E. ASTM A123: Specification for Zinc (Hot Galvanized) Coatings on Iron and Steel

F. ASTM A510: Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel

G. ANSI/TIA 569-C: Telecommunications Pathways and Spaces

H. ANSI/TIA 568-C.0, 1, 2, 3, 4: Commercial Building Telecommunications Standard

I. ANSI/TIA-598-C-2005 – Optical Fiber Cable Color Coding

J. ANSI/TIA 606-B: Administration Standard for Telecommunications Infrastructure

K. ANSI/TIA 942-A: Telecommunications Infrastructure Standard for Data Centers

L. ANSI/TIA 607-B: Generic Telecommunications Grounding (Earthing) and Bonding for Customer Premises

M. IEEE: National Electrical Safety Code® (NESC®)
standards.ieee.org/about/nesc

1.5 QUALIFICATIONS

A. Refer to Section 270000 for additional requirements.

B. Premises Distribution System: Written certification that the premises distribution system complies with the EIA ANSI/TIA/EIA-568-C.0,1, 2, 3, EIA ANSI/TIA/EIA-569-B, and ANSI/TIA/EIA-606-A.

C. Materials and Equipment: Where materials or equipment are specified to conform, be constructed, or be tested to meet specific requirements, Contractor shall supply, upon request by the Consultant or Owner, a certification that the items provided conform to such requirements. Certification by a nationally recognized testing laboratory that a representative sample has been tested to meet the requirements or a published catalog specification statement to the effect that the item meets the referenced standard will be acceptable as evidence that the item conforms. Compliance with these requirements does not relieve Contractor from compliance with other requirements of the specifications.

D. Certifications

1. Contractor shall have an RCDD (Registered Communication Distribution Designer) on staff assigned to manage this Project; documented proof shall accompany the proposal response.
2. All installing personnel shall have completed and be certified in manufacturer training, or BICSI (Building Industry Consulting Service International) installation training for UTP infrastructure systems, or Contractor shall contract with the manufacturer for the installation of all proposed components. Company Certifications shall accompany the proposal response.
3. Contractor’s technicians shall be certified and trained in the connectivity hardware which is being installed.
4. Contractor shall submit certification that installers are factory certified to install and test the provided products. No less than half of the crew to be used for the telecommunications installation shall be trained by that manufacturer for the work.

1.6 PRE-CONSTRUCTION SUBMITTALS

A. Shop Drawings in addition to requirements in Section 270000:

1. Equipment rack elevation details
2. Elevations of telecommunication room walls with planned mounted equipment
3. Outlet faceplate details for all outlet configurations, sizes, and cable types
4. Overhead telecommunication room enlargements, providing dimensions of room and clearance for maintenance and operation

1.7 CONSTRUCTION PROGRESS SUBMITTALS

A. Refer to Section 270000 for requirements.

1.8 CLOSEOUT SUBMITTALS

A. Refer to Section 270000 for requirements.

1. Data cable test results
2. CD containing:

a. As-built drawings (CAD format)
b. As-built drawings (PDF format)
c. Detailed test results in original tester format (e.g., Fluke Linkware)
d. Detailed cable test results in PDF format

3. Warranty certification from the connectivity manufacturer

1.9 DELIVERY, STORAGE, AND HANDLING

A. Contractor shall be responsible for all materials until the completion of the Project.

B. Cable shall be stored according to the manufacturer’s recommendations at a minimum. In addition, cable shall be stored in a location protected from vandalism and weather.

C. If the cable is stored outside, it shall be covered with opaque plastic or canvas with provision for ventilation to prevent condensation and protection from the weather. If the air temperature at the cable storage location is below 40 degrees Fahrenheit, the cable shall be moved to a heated (minimum 50 degrees Fahrenheit) location. If necessary, cable shall be stored off-site at Contractor’s expense.

D. If Contractor wishes to have a trailer on site for the storage of materials, arrangements shall be made with the Owner.

E. Commercial off-the-shelf manuals shall be furnished for operation, installation, configuration, and maintenance for all products provided as a part of the premises distribution system. Specification sheets for all cables, connectors, and other equipment shall be provided.

PART 2 - PRODUCTS

2.1 SUBSTITUTIONS

A. Unless noted otherwise, products in this section are intended as a basis of design and are open to substitutions per the product substitution procedures defined in Section 270000.

PART 3 - EXECUTION

3.1 TESTING

A. Refer to Section 270000 for additional requirements.

3.2 TRAINING

A. Refer to Section 270000 for additional requirements.

3.3 WARRANTY

A. Refer to Section 270000 for additional requirements.

B. Contractor shall provide to the Owner a manufacturer's 15-year minimum warranty certificate for all materials, equipment, etc. Upon successful completion of the installation and subsequent inspection, the Owner shall receive the numbered certificate from the manufacturing connectivity hardware (patch panels, jacks, patch cords, 110 blocks, etc.) company registering the installation. This warranty shall include all labor, materials, and travel time.

C. The warranty shall ensure against product defects and guarantee that all approved cabling components exceed the specifications of TIA/EIA-568-C and ISO/IEC IS 11801 for cabling links/channels and that the installation will exceed the loss and bandwidth requirements of TIA/EIA 568-C ISO/IEC IS 11801 for fiber links/channels for a fifteen (15) year period. The warranty shall apply to all passive structured cabling system components.

D. The warranty shall cover the failure of the wiring system to support the application that it was designed to support, as well as additional application(s) introduced in the future by recognized standards or user forums that use the TIA/EIA 568-C or ISO/IEC IS 11801 component and link/channel specifications for cabling. Such warranty shall apply for a minimum of a fifteen (15) year period.

E. The warranty shall cover the replacement or repair of the defective product(s) and labor for the replacement or repair of such defective products(s), labeling of the new components, and testing of the circuit(s) at no cost to the Owner.

3.4 EXAMINATION

A. Verification of Conditions: Contractor shall examine areas and conditions under which work is to be performed and identify conditions detrimental to proper and timely completion.

B. Contractor shall verify that cable lengths comply with published standards.

C. Contractor shall notify the Owner of any proposed installation which is expected to exceed the maximum lengths prior to the installation of the cable.

D. Contactor shall consult with the Owner regarding alternative routing or location of the cable.

E. Contractor shall not proceed until unsatisfactory conditions have been corrected.

3.5 SPARE PARTS

A. Suggested List: Contractor is requested to submit a list of suggested spare parts with an offered price, allowing the Owner to select appropriate parts.

B. Means of Obtainment: Contractor shall state where spare parts can be obtained after the installation.

3.6 INSTALLATION REQUIREMENTS

A. Refer to Section 270000 for additional requirements.

3.7 COOPERATION

A. Contractor shall cooperate with other trades and General Contractor’s personnel in locating work in a proper manner.

B. Should it be necessary to raise, lower, or move longitudinally any part of the work to better fit the general installation, such work shall be done at no extra cost to the Owner, provided such decision is reached prior to the actual installation. Contractor shall check the location of electrical outlets with respect to other installations before installing.

3.8 TESTING AND ACCEPTANCE

A. Contractor shall perform acceptance tests as indicated below for each subsystem (backbone, station, etc.) as it is completed.

B. Contractor shall supply all equipment and personnel necessary to conduct the acceptance tests. Prior to testing, Contractor shall provide a summary of the proposed test plan for each cable type, including equipment to use, setup, test frequencies or wavelengths, results format, etc. The Consultant will approve the method of testing.

C. Contractor shall visually inspect all cabling and termination points to ensure that they are complete and conform to the wiring pattern defined herein. Contractor shall provide the Consultant with a written certification that this inspection has been made.

D. Contractor shall conduct acceptance testing according to a schedule coordinated with the Consultant. Representatives of the Owner may be in attendance to witness the test procedures. Contractor shall provide a minimum of one (1) week advance notice to the Consultant and Owner to allow for such participation. The notification shall include a written description of the proposed conduct of the tests, including copies of blank test result sheets to be used.

E. Tests related to connected equipment of others shall be done only with the permission and presence of Contractor involved. Contractor shall ascertain that testing only as required to prove the wiring connections are correct.

F. Contractor shall provide the Consultant with test results and descriptions of the testing methodology, including the date of the tests, the equipment used, and the procedures followed. At the request of the Consultant, Contractor shall provide copies of the original test results.

G. All cabling shall be 100% fault free unless noted otherwise. If any cable is found to be outside the specification defined herein, that cable and the associated termination(s) shall be replaced at Contractor's expense. The applicable tests shall then be repeated.

H. Backbone voice cables shall be free of shorts within the pairs and be verified for continuity, pair validity and polarity, and conductor position on the termination blocks (e.g., 110). Any mispositioned pairs shall be identified and corrected. The percentage of "bad" pairs shall not exceed 1% in any backbone (riser or tie) cable based on the total pair count. All bad pairs shall be identified and documented.

I. The Consultant or Owner may request that a 10% random field re-test be conducted on the cable system to verify documented findings.

1. If requested, Contractor shall test up to 10% of cable links at no cost to the Owner.
2. Tests shall be a repeat of those defined above and under Testing and Acceptance. If findings contradict the documentation submitted by Contractor, additional testing shall be performed to the extent determined necessary by the Consultant, including a 100% re-test. This re-test shall be at no additional cost to the Owner.

3.9 FIRE STOPPING

A. Contractor shall seal any openings created for cable pass-through between floors or through fire-rated walls. Sealing material and application of this material shall be accomplished in such a manner that is acceptable to the local fire and building authorities having jurisdiction over this work.

B. Creation of such openings as are necessary for cable passage between locations as shown on the Drawings shall be the responsibility of Contractor. Any openings created by or for Contractor and left unused shall also be sealed as part of this work.

END OF SECTION 270500

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SECTION 270526 - GROUNDING AND BONDING FOR TECHNOLOGY SYSTEMS

PART 1 - GENERAL

1.1 SCOPE

A. Refer to Section 270000 for additional project scope information.

1.2 RELATED WORK

A. Section 270000 – General Technology Requirements

B. Section 270500 – Communications General Requirements

C. Section 270526 – Grounding and Bonding for Technology Systems

D. Section 270528 – Pathways for Technology Systems

E. Section 270537 – Firestopping for Technology Systems

F. Section 271100 – Communications Equipment Rooms

G. Section 271300 – Communications Backbone Cabling

H. Section 271500 – Communications Horizontal Cabling

I. Section 271600 – Communications Connecting Cords

J. Section 271800 – Communications Labeling and Identification

K. Section 274000 – AV/Multimedia General Requirements

L. Section 274100 – Audio Visual Systems

M. Section 275100 – Distributed Communications Systems

N. Section 276000 – Physical Security General Requirements

O. Section 276200 – Electronic Access Control System

P. Section 276400 – Video Surveillance System

Q. Section 276600 – Intrusion Detection System

1.3 DEFINITIONS

A. Refer to Section 270000 for additional definitions.

1.4 REFERENCE STANDARDS AND CODES

A. IEEE C2 - National Electrical Safely Code

B. IEEE Std. 837-2002, or latest version – Standard for Qualifying Permanent Connections Used in Substation Grounding

C. ANSI/TIA-607 - Commercial Building Grounding and Bonding Requirements for Telecommunications

D. NFPA 70E - Standard for Electrical Safely in the Workplace

E. ANSI/NECA/BICSI-607 - Telecommunications Bonding and Grounding Planning and Installation methods for Commercial Buildings

F. UL 467 - Standard for Grounding and Bonding Equipment

G. Refer to Section 270000 for additional requirements.

1.5 QUALIFICATIONS

A. Refer to Section 270000 for additional requirements.

1.6 PRE-CONSTRUCTION SUBMITTALS

A. Refer to Section 270000 for additional requirements.

1.7 CONSTRUCTION PROGRESS SUBMITTALS

A. Refer to Section 270000 for additional requirements.

1.8 CLOSEOUT SUBMITTALS

A. Refer to Section 270000 for additional requirements.

PART 2 - PRODUCTS

2.1 SUBSTITUTIONS

A. Unless noted otherwise, products in this section are intended as a basis of design and are open to substitutions per the product substitution procedures defined in Section 270000.

2.2 GROUNDING AND BONDING CABLE

A. The grounding and bonding cable shall be stranded copper conductors.

B. The grounding and bonding cables shall have a green jacket color and riser, or plenum rated as required.

C. Feeder and Branch Circuit Equipment Ground: Size as shown on drawings, specifications, or as required by NFPA 70, whichever is larger. Differentiate between normal ground and isolated ground when both are used within the same facility.

2.3 GROUNDING AND BONDING BUSBARS

A. Telecommunications Main Grounding Busbar (TMGB)

1. Factory-drilled solid copper with holes to accommodate lugs. Field-manufactured busbars are not acceptable.
2. 0.25” thick x 4” wide
3. Sized for current applications and future growth, no less than 18”
4. Insulated from its support
5. Shall be an electro-tin-plated busbar
6. Maintain a minimum of 2” of clearance from the wall
7. UL-listed and BICSI certified

B. Telecommunications Grounding Busbar (TGB)

1. Factory-drilled solid copper with holes to accommodate lugs. Field-manufactured busbars are not acceptable.
2. 0.25” thick x 4” wide
3. Sized for current applications and future growth, no less than 12”
4. Insulated from its support
5. Shall be an electro-tin-plated busbar
6. Maintain a minimum of 2” of clearance from the wall
7. UL-listed and BICSI certified

C. Horizontal Equipment Rack or Cabinet Busbar

1. Mounts to standard 19” Rack or Frame
2. Capacity: 6 Double hole lugs
3. Shall be an electro-tin-plated busbar

4. UL-listed and BICSI certified

D. Vertical Equipment Rack or Cabinet Busbar

1. Mounts to vertical rail or inside of the cabinet in 19” or 23” equipment rack or frame.
2. Capacity: 9 Double hole lugs
3. Shall be an electro-tin-plated busbar
4. UL-listed and BICSI certified

2.4 MECHANICAL CONNECTORS

A. Mechanical connector bodies shall be manufactured from high-strength, high-conductivity cast copper alloy material. Bolts, nuts, washers, and lock washers shall be made of Silicon Bronze and supplied as a part of the connector body and shall be of the two-bolt type.

B. Split bolt connector types are not allowed.

C. Connectors shall meet or exceed UL 467.

2.5 COMPRESSION LUGS

A. Shall be UL & CSA listed

B. Shall meet or exceed the performance requirements of IEEE 837, latest revision

C. Compression type

D. Shall be manufactured from pure wrought copper. Conductivity of this material shall be no less than 99% by IACS standards.

E. Shall be electro-tin plated

F. Lugs shall be 2-hole. Single-hole lugs are not allowed

G. Long barrel that will allow a minimum of two crimps with standard industry colors

H. Each connector shall be filled with an oxide-inhibiting compound

I. Crimped with a compression, tool, and die system, according to the manufacturer’s recommendation

2.6 TAPS

A. Connections to the Conductor shall be made with irreversible compression connectors.

B. Shall be UL & CSA listed

C. Requires a minimum of (2) crimps for C Tap or H Tap, 1 crimp for I-Beam and busbar Tap

D. Crimp according to manufacturer's recommendation

PART 3 - EXECUTION

3.1 GENERAL

A. Install products in accordance with the manufacturer's recommendations.

B. Inspect grounding and bonding system conductors and connections for tightness and proper installation.

C. Mechanical connections shall be accessible for inspection and maintenance.

D. No insulation shall be installed over mechanical ground connections.

E. Ground connection surfaces shall be cleaned, and all connections shall be made so that disconnection or removal is impossible.

3.2 RESISTANCE MEASUREMENT

A. Measure ground resistance from the system-neutral connection at the service entrance to a convenient ground reference point using suitable ground testing equipment. Resistance shall not exceed 2 ohms.

3.3 TELECOMMUNICATIONS BONDING BACKBONE (TBB)

A. The intended function of a TBB is to reduce or equalize potential differences between telecommunications systems. While the TBB will carry some current under ac power ground fault conditions, it is not intended to provide the only ground fault return path.

B. The TBB shall:

1. Be connected to the TMGB & TGB.
2. Be a continuous copper conductor that shall be sized no less than 6 AWG to a maximum of 3/0 AWG. The TBB shall be sized in accordance with the following table:

Linear Length – ft.	Size (AWG)
Less than 13	6
14 - 20	4
21 - 26	3
27 - 33	2
34 - 41	1
42 - 52	1/0
53 - 66	2/0
Greater than 67'	3/0

3. The TBB conductors shall be installed and protected from physical and mechanical damage.
4. The TBB conductors should be installed without splices.

    a. Where splices are necessary, the number of splices should be kept to a minimum, and they shall be accessible and located within telecommunications spaces or j-box labeled as a telecommunications bonding backbone splice.
    b. Joined segments of a TBB shall be connected using exothermic welding, irreversible compression-type connectors, or equal.

C. A metallic cable shield shall not be used as a TBB.

3.4 GROUNDING EQUALIZER (GE)

A. The GE shall be a continuous copper conductor that shall be sized no less than 6 AWG to a maximum of 3/0 AWG. The GE shall match the size of the TBB.

B. The GE shall connect to the telecommunications grounding busbar(s) in the same-floor telecommunications rooms on the first, top, and every third floor in a building greater than 4 floors.

C. A metallic cable shield shall not be used as a GE.

3.5 TELECOMMUNICATIONS EQUIPMENT BONDING CONDUCTOR (TEBC)

A. Connects the TMGB/TGB to equipment racks and cabinets.

B. Shall be a continuous copper conductor that shall be sized per the length of cable.

C. Shall be separated from ferrous materials by 2” or be bonded to the ferrous metal.

D. May be routed within cable trays or suspended 2” under or off the side of the cable tray or ladder rack.

E. Shall be supported every 3ft.

F. 8” minimum bend radius.

G. May come across other cable groups at a 90-degree angle only.

H. A metallic cable shield shall not be used as a TEBC.

3.6 RACK OR CABINET BONDING CONDUCTOR

A. A bonding conductor shall be used to connect the equipment racks and cabinets directly to the TMGB, TGB, or underfloor ground mesh network.

B. All metallic enclosures, including remote-mounted equipment cabinets and racks for telecommunications, security, or audio/visual, shall be bonded to the nearest TMGB or TGB using a minimum-sized conductor of 6 AWG. Remote bonds shall be labeled on both ends stating the destination of the bond.

3.7 ELECTRICAL DISTRIBUTION PANEL (EDP)

A. The AC EDP serving the Telecommunications Room shall be bonded to the TMGB or TGB using a minimum of a 6 AWG cable.

B. A qualified electrician shall make all connections within an AC electrical distribution panel.

3.8 OPTICAL FIBER CONDUCTIVE CABLES

A. Conductive fiber-optic cables should be bonded and grounded as specified in the NEC.

3.9 CONDUIT AND SLEEVE BONDING

A. All conduits and sleeves entering a telecommunications room shall be grounded.

3.10 LADDER RACK AND/OR CABLE TRAY

A. All low voltage cable runway sections shall be bonded together and bonded back to the nearest Telecommunications Room the runway is serving as close TMGB or TGB as practical.

B. Maintain an 8” minimum bend radius on the TEBC.

C. Keep a 2” separation from other cables, both power and telecommunications.

D. Remove any paint, oxidation, etc., from the runway surfaces that are being bonded.

E. Drill two holes as required to accommodate the 2-hole compression lug.

F. Apply a thin coat of antioxidant around the holes and on the surface where the lug will be in contact.

G. Attach straps to the runway using stainless steel hardware sized for the lug holes.

H. Wipe off any excess antioxidant after installation of the lug.

3.11 BUILDING STEEL

A. Each ground bus bar shall be bonded to building steel.

B. Remove any paint or fire-stopping spray from the building steel.

C. Provide the appropriate bonding connector to connect to beams, trusses, or other types of structure.

3.12 LABELING

A. Each grounding/bonding cable shall be labeled at the TMGB or TGB.

B. All taps to the TBB shall be within an enclosure and labeled as to their purpose.

C. Mechanical connectors shall be clearly marked with the catalog number, conductor size, and manufacturer.

D. Compression lugs shall be clearly marked with the manufacturer, catalog number, conductor size, and required compression tool settings.

3.13 TESTING

A. Refer to Section 270000 for additional requirements.

B. Perform testing in accordance with the test instrument manufacturer’s recommendations using the fall-of-potential method.

3.14 TRAINING

A. Refer to Section 270000 for additional requirements.

3.15 WARRANTY

A. Refer to Section 270000 for additional requirements.

END OF SECTION 270526

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SECTION 270528 - PATHWAYS FOR TECHNOLOGY SYSTEMS

PART 1 - GENERAL

1.1 SCOPE

A. In areas where there is no remodeling, utilize existing pathways, conduits, and rough-in.

B. Refer to Section 270000 for additional project scope information.

C. Contractor is to provide pathways to all devices to the closest accessible ceiling.

1.2 RELATED WORK

A. Section 270000 – General Technology Requirements

B. Section 270500 – Communications General Requirements

C. Section 270526 – Grounding and Bonding for Technology Systems

D. Section 270528 – Pathways for Technology Systems

E. Section 270537 – Firestopping for Technology Systems

F. Section 271100 – Communications Equipment Rooms

G. Section 271300 – Communications Backbone Cabling

H. Section 271500 – Communications Horizontal Cabling

I. Section 271600 – Communications Connecting Cords

J. Section 271800 – Communications Labeling and Identification

K. Section 274000 – AV/Multimedia General Requirements

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M. Section 275100 – Distributed Communications Systems

N. Section 276000 – Physical Security General Requirements

O. Section 276200 – Electronic Access Control System

P. Section 276400 – Video Surveillance System

Q. Section 276600 – Intrusion Detection System

1.3 DEFINITIONS

A. Refer to Section 270000 for additional definitions.

1.4 REFERENCE STANDARDS AND CODES

A. Refer to Section 270000 for additional requirements.

1.5 QUALIFICATIONS

A. Refer to Section 270000 for additional requirements.

1.6 PRE-CONSTRUCTION SUBMITTALS

A. Refer to Section 270000 for additional requirements.

1.7 CONSTRUCTION PROGRESS SUBMITTALS

A. Refer to Section 270000 for additional requirements.

1.8 CLOSEOUT SUBMITTALS

A. Refer to Section 270000 for additional requirements.

PART 2 - PRODUCTS

2.1 SUBSTITUTIONS

A. Unless noted otherwise, products in this section are intended as a basis of design and are open to substitutions per the product substitution procedures defined in Section 270000.

1.

2.2 CABLE HOOK SYSTEMS

A. In the areas where the cables are required to be run in a “free-air” plenum, a cable hook system shall be used.

B. Cable hooks shall be capable of supporting a minimum of 30 lbs. with a safety factor of 3.

C. Spring steel cable hooks shall be capable of supporting a minimum of 100 lbs. with a safety factor of 3 where extra strength is required.

D. Cable hooks shall be Category 6a or better rated.

E. Follow the manufacturer's recommendations for allowable fill capacity for each size of cable hook.

F. Installation and configuration shall conform to the requirements of the ANSI/ EIA/TIA Standards 568A & 569, NFPA 70 (National Electrical Code), and applicable local codes.

G. Cable hooks shall:

1. Have a flat bottom and provide a minimum of 1 5/8" cable-bearing surface.
2. Have 90-degree radiused edges to prevent damage while installing cables.
3. Be designed so the mounting hardware is recessed to prevent cable damage.
4. Have a steel cable latch retainer to provide containment of cables within the hook.
5. Have a retainer that shall be removable and reusable.
6. Be factory assembled for direct attachment to walls, hanger rods, beam flanges, purlins, strut, and floor posts, to meet job conditions.

H. Factory assembled multi-tiered cable hooks shall be used where required to provide separate cabling compartments or where additional capacity is needed.

I. Cable hooks for non-corrosive areas shall be pre-galvanized steel, ASTM A653 G90. Where additional strength is required, cable hooks shall be spring steel with a zinc-plated finish, ASTM B633, SC3.

J. Cable hooks for corrosive areas shall be stainless steel, AISI type 304.

K. Cable hooks shall be B-Line series BCH21, BCH32, or other manufacturers that meet these specifications.

2.3 CABLE PATHWAY SLEEVES

A. Contractor shall only provide when re-enterable sleeves are not possible.

B. Contractor shall provide all necessary wall penetration for cable pathways whether or not specifically shown on Project Drawings.

C. All wall penetrations shall have a metallic sleeve(s) as required to maintain a maximum 40% fill ratio.

D. All sleeves shall be properly fire-stopped by Contractor.

E. Contractor shall provide all core holes, pathways, and sleeves (minimum 1.25" c).

F. Contractor shall install non-metallic threadless insulating bushings on the end of all conduits.

G. Conduit Core Holes and Sleeves thru Floor: For all floor penetrations, Contractor shall provide IMC conduits with threaded steel couplings set flush with finish floor. Extend 6" above finish floor with IMC before any termination.

2.4 RE-ENTERABLE FIRESTOP SLEEVES

A. Device modules comprised of steel pathway with self-adjusting intumescent foam pads/membrane allowing 0 to 100 percent visual cable fill.

B. Refer to the drawings for the required sizes. If not specifically identified, utilize 2” or greater as required for cabling counts with 20% additional capacity for future growth.

C. Manufacturer:

1. STI EZ Path
2. Hilti Speedsleeve

2.5 METAL CONDUITS AND FITTINGS

A. General Requirements for Metal Conduits and Fittings:

1. Listed and labeled as defined in NFPA 70 by a qualified testing agency and marked for intended location and application.
2. Comply with TIA-569-B.
3. GRC: Comply with ANSI C80.1 and UL 6.
4. EMT: Comply with ANSI C80.3 and UL 797.
5. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.

    a. Fittings for EMT:

        1) Material: Steel
        2) Type: Setscrew

6. Expansion Fittings: Steel to match conduit type, complying with UL-467, rated for environmental conditions where installed, and including flexible external bonding jumper.

2.6 OUTLET BOXES

A. General Requirements for Outlet Boxes

1. Comply with TIA-569-B.

B. Metallic outlet boxes and device covers shall be galvanized steel not less than 1/16’ thick.

C. The dimensions of the metallic outlet box shall be 2’x4", 4"x4", and 6"x4" with a minimum depth of 2.5" (Finished depth shall be at least 3.5” deep for proper cable routing and bend radius). See drawings for details.

D. Metallic outlet boxes shall be equipped with a single-device cover (or two-device cover where needed).

E. Where installed in plaster, gypsum board, etc., covers shall be raised to compensate the thickness of the wall.

F. Box extensions used to accommodate new building finishes shall be of the same material as a recessed box.

G. Where metallic outlet boxes are to be empty for future use, blank covers shall be used.

H. Gangable boxes are not allowed.

2.7 PAINTING

A. Contractor is responsible for painting all exposed pathways, boxes, fittings, etc. The paint shall match the surrounding conditions and may change mid-run.

PART 3 - EXECUTION

3.1 TESTING

A. Refer to Section 270000 for additional requirements.

3.2 TRAINING

A. Refer to Section 270000 for additional requirements.

3.3 WARRANTY

A. Refer to Section 270000 for additional requirements.

3.4 CABLE HOOK SYSTEM

A. J-hooks fabricated to contain data/voice and video cables may be used to support 25 or fewer cables in each hook. J-hooks are to be fastened to building steel with beam clamps, suspended from the ceiling slab with threaded rod, or anchored to the wall. All J-hooks shall be hung straight and level. No other installation technique will be authorized unless pre-approved.

B. Three-tiered double-sided J-hook configurations shall contain a maximum of 25 cables per hook or 150 cables. Smaller configurations may be used as bundles decrease in size, maintaining no more than 25 cables per hook.

C. Bundles surpassing 150 cables shall be supported by hangers fabricated of 3/8” threaded rod and 24” Unistrut. Hangers shall also be installed where the installation of a three-tiered J-hook system is not appropriate for the ceiling space or where blocked by other trades’ work.

D. Cable bundles consisting of fewer than 10 cables may be supported by single J hooks.

E. All cable support in the main cable path shall be installed every four feet. Small cable bundles (under 25) not in the main path may be supported every five feet.

F. A sag shall be maintained between supports of 6” to reduce cable strain. Velcro is an appropriate method of securing cables when properly used and not over-tightened.

G. Proper cable support is extremely important to the Owner, and care shall be taken by Contractor to provide and install the appropriate supports. Supports found to be inadequate will be replaced.

H. Cable bundles, including voice/data cabling, shall not have plastic cable ties.

I. All cable trunks shall have radius-controlled cable waterfalls where the trunk drops from the conduit, sleeve, or tray from the horizontal path to the vertical path.

3.5 PATHWAY APPLICATIONS

A. Indoors: Apply pathway products as specified below unless otherwise indicated:

1. Exposed, Not Subject to Physical Damage: EMT
2. Concealed in Ceilings and Interior Walls and Partitions: EMT

B. Minimum Pathway Size for Data: 1-inch trade size. Cable fill shall not exceed a 40% fill ratio.

C. Pathway Fittings: Compatible with pathways and suitable for use and location.

1. Rigid Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
2. EMT: Use setscrew and steel fittings. Comply with NEMA FB 2.10.

3.6 INSTALLATION

A. Comply with NECA 1, NECA 101, and TIA-569-B for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NFPA 70 limitations for types of pathways allowed in specific occupancies and number of floors.

B. Keep pathways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal pathway runs above water and steam piping.

C. Complete pathway installation before starting conductor installation.

D. Arrange stub-ups so curved portions of bends are not visible above the finished slab.

E. Install no more than the equivalent of two 90-degree bends in any pathway run. Support within 12 inches of changes in direction. Utilize long radius ells for all optical-fiber cables.

F. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

G. Support conduit within 12 inches of enclosures to which attached.

H. All conduit penetrations shall comply with all applicable fire codes. All conduit penetrations in fire-rated walls or floors shall be sealed and fireproofed to at least the rating of the penetration area.

I. Conduits shall be routed in the most direct route, with the fewest number of bends.

J. There shall be no continuous conduit sections longer than 100 feet. For runs that total more than 100 feet, insert junction or pull boxes (or gutters if appropriate) so that no continuous run between pull boxes is greater than 100 feet.

K. There shall be no more than two 90-degree bends (180 degrees total) between conduit pull boxes.

L. Changes in direction shall be accomplished with sweeping bends observing the minimum bend radius requirements above. Do not use pull boxes for direction changes unless specifically designated otherwise in the Drawings.

M. Stub-ups to Above Recessed Ceilings:

1. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

N. Terminate threaded conduits into threaded hubs or with locknuts on the inside and outside of boxes or cabinets. Install insulated bushings on conduits terminated with locknuts.

O. Install pathways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.

P. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling the conduit to the enclosure to ensure a continuous ground path.

Q. Cut conduit perpendicular to the length. For conduits of 2-inch trade size and larger, use a roll cutter or a guide to ensure the cut is straight and perpendicular to the length.

R. Install pull wires in empty pathways. Use polypropylene or monofilament plastic line with not less than 200-lb. tensile strength. Leave at least 12 inches of slack at each end of the pull wire. Cap underground pathways designated as spare above grade alongside pathways in use.

3.7 OUTLET BOXES

A. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to the center of the box unless otherwise indicated.

B. Exact locations of the outlet boxes shall be coordinated with the Electrical Contractor and other trades.

C. The approximate locations of the outlets are indicated on the drawings. The exact locations shall be determined at the building. The right is reserved to change, without additional cost, the exact location of any outlet, a maximum of 10' before it is permanently installed.

D. Recessed Boxes in Masonry Walls: Saw-cut opening for box in the center of the cell of masonry block and install box flush with the surface of the wall. Prepare block surface to provide a flat surface for a rain-tight connection between the box and cover plate or supported equipment and box.

E. Horizontally separate boxes by a minimum of 12’ mounted on opposite sides of walls so they are not in the same vertical channel.

F. Outlet boxes installed back-to-back in fire-rated walls shall be separated horizontally by a minimum of 24".

G. Install all outlet boxes in finished areas flush with the wall. Maintain ¼" or less space between the outlet box front and the finished wall surface.

H. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.

I. Outlet boxes shall be firmly anchored in place and shall not depend on the cover plate to hold them securely to the wall.

J. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

K. Any surface boxes shall have rounded corners and edges. Surface boxes must be approved by Owner prior to installation.

3.8 RISER CONDUITS

A. Conduits entering equipment rooms shall be reamed or bushed and terminated not more than 4" from a wall and within 12” of room corners.

B. Conduits entering equipment rooms from below the floor shall be terminated not more than 4" above the finished floor.

C. Conduits shall not be less than 4" trade size and be equipped with a measured pull line at 12” increments rated at a minimum 1200-pound test.

D. Provide restorable fire stops inside and around conduits as recommended by UL1479 or ASTM E814 for all conduits penetrating fire-rated construction.

E. Provide an insulating press fit bushing on all telecommunications riser conduits. Bushings must be rated to be used in an environmental air handling space (Plenum).

3.9 SLEEVE-SEAL INSTALLATION FOR COMMUNICATIONS PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies.

3.10 FIRESTOPPING

A. Install fire stopping at penetrations of fire-rated floor and wall assemblies.

END OF SECTION 270528

SECTION 270537 - FIRESTOPPING FOR TECHNOLOGY SYSTEMS

PART 1 - GENERAL

1.1 SCOPE

A. All penetrations of walls shall be approved by the General Contractor before any penetrations are made. Should Contractor find it necessary to penetrate any walls extending to the slab, it will be the responsibility of that Contractor to provide satisfactory sleeving and fire caulking both inside and outside of that sleeving. If existing sleeving is to be utilized, it will be the responsibility of Contractor to fire caulk inside the sleeving.

B. Refer to Section 270000 for additional project scope information.

1.2 RELATED WORK

A. Division 7 - Firestopping

B. Section 270000 – General Technology Requirements

C. Section 270500 – Communications General Requirements

D. Section 270526 – Grounding and Bonding for Technology Systems

E. Section 270528 – Pathways for Technology Systems

F. Section 270537 – Firestopping for Technology Systems

G. Section 271100 – Communications Equipment Rooms

H. Section 271300 – Communications Backbone Cabling

I. Section 271500 – Communications Horizontal Cabling

J. Section 271600 – Communications Connecting Cords

K. Section 271800 – Communications Labeling and Identification

L. Section 274000 – AV/Multimedia General Requirements

M. Section 274100 – Audio Visual Systems

N. Section 275100 – Distributed Communications Systems

O. Section 276000 – Physical Security General Requirements

P. Section 276200 – Electronic Access Control System

Q. Section 276400 – Video Surveillance System

R. Section 276600 – Intrusion Detection System

1.3 DEFINITIONS

A. Refer to Section 270000 for additional definitions.

1.4 REFERENCE STANDARDS AND CODES

A. ANSI/TIA-1179-A “Healthcare Facility Telecommunications Infrastructure.”

B. ANSI/TIA-EIA-569-D “Telecommunications Pathways and Spaces”

C. ASTM E90, “Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.”

D. ASTM E814, “Fire Tests of Through Penetration Firestops.”

E. ASTM E1725, “Standard Test Methods for Fire Tests of Fire-Resistive Barrier Systems for Electrical System Components.”

F. CAN/ULC S115, "Standard Method of Fire Tests of Firestops Systems."

G. UL 1479, “Fire Tests of Through Penetration Firestops.”

H. National Fire Protection Association (NFPA) – NFPA 101: Life Safety Code.

I. National Fire Protection Association (NFPA) – NFPA 70: National Electrical Code.

J. Underwriters Laboratories Inc. (UL) – Fire Resistance Directory

K. Refer to Section 270000 for additional requirements.

1.5 QUALIFICATIONS

A. Refer to Section 270000 for additional requirements.

1.6 PRE-CONSTRUCTION SUBMITTALS

A. Refer to Section 270000 for additional requirements.

1.7 CONSTRUCTION PROGRESS SUBMITTALS

A. Refer to Section 270000 for additional requirements.

1.8 CLOSEOUT SUBMITTALS

A. Refer to Section 270000 for additional requirements.

PART 2 - PRODUCTS

2.1 SUBSTITUTIONS

A. Unless noted otherwise, products in this section are intended as a basis of design and are open to substitutions per the product substitution procedures defined in Section 270000.

2.2 GENERAL PERFORMANCE REQUIREMENTS

A. Fire-rated cable pathway devices shall be used in fire-rated construction for all low-voltage or optical fiber raceways. Such devices shall:

1. Meet the hourly fire-rating of fire-rated wall and or floor penetrated.
2. Be tested for the surrounding construction and cable types involved.
3. Re-enterable firestop pathway shall have UL Systems permitting cable loads from zero to 100% visual fill.
4. Re-enterable firestop pathway shall be maintenance-free as defined by not requiring the removal and or replacement of any material such as, but not limited to, firestop caulk, putty, pillows, bags, foam muffins, foam, foam plugs, foam blocks, or foam closures of any sort.
5. Pathways shall be engineered such that two or more devices may be ganged together for additional cable capacities.
6. Affix adhesive wall label immediately adjacent to devices to communicate to future cable technicians, authorities having jurisdiction, and others the manufacturer of the device and the corresponding UL System number installed.
7. Size as shown on the drawings or as required when not specifically identified.

B. Non-rated cable pathway devices shall be used in non-fire-rated construction, such as smoke partitions for all low-voltage and fiber optic cabling where frequent cable moves, adds, and changes may occur. Such devices shall:

1. Limit the movement of smoke and sound of wall and or floor penetrated.
2. Restore the STC Rating of the penetrated assembly.
3. Provide L Ratings of greater than 1 CFM when empty and greater than 2.5 CFM at all other loadings up to 100 percent.
4. Accommodate cable loads from zero to 100% visual fill.
5. Be maintenance-free as defined by not requiring the removal and or replacement of any material such as, but not limited to, firestop caulk, putty, pillows, bags, foam muffins, foam, foam plugs, foam blocks, or foam closures of any sort.
6. Pathways shall be engineered such that two or more devices may be ganged together for larger cable capacities.
7. Pathways shall be engineered to be re-enterable so they can be retrofitted and removed from around existing cables without cutting and re-splicing them.

8. Affix adhesive wall label immediately adjacent to devices to communicate to future cable technicians, authorities having jurisdiction, and others the manufacturer of the device and the corresponding UL System number installed.

C. Where non-mechanical pathways must be utilized, such as sealing (caulking) around single or grouped conduits, provide products that, upon curing, do not re-emulsify, dissolve, leach, breakdown, or otherwise deteriorate over time from exposure to atmospheric moisture, sweating pipes, ponding water, or other forms of moisture characteristic during or after construction.

D. Cable tray shall terminate at each barrier and resume on the other side such that cables pass independently through devices. Cable tray shall be properly supported on each side of the barrier.

E. Single Source: Obtain firestop systems for each type of penetration and construction condition indicated only by a single manufacturer.

2.3 MATERIALS

A. General: Use only products that have been tested for specific fire resistance-rated construction conditions or acoustical and smoke-related requirements conforming to construction assembly type, penetrating item type, annular space requirements, and rating involved for each separate instance.

B. Firestop Sealants: Single-component latex formulations that, upon cure, do not re-emulsify during exposure to moisture. The following products are acceptable:

1. Specified Technologies Inc. (STI) SpecSeal Series SSS or LCI Sealant.
2. Hilti

C. Firestop Putty: Intumescent, non-hardening, water-resistant putties containing no solvents, inorganic fibers, or silicone compounds. The following products are acceptable:

1. Specified Technologies Inc. (STI) SpecSeal Series SSP Putty.
2. Hilti

D. Firestop Pillows: Re-enterable, non-curing, mineral fiber core encapsulated on six sides with intumescent coating contained in a flame-retardant poly bag. The following products are acceptable:

1. Specified Technologies Inc. (STI) SpecSeal Series SSB Pillows.
2. Hilti

E. Fire-Rated Cable Grommet: Molded, two-piece grommet with an integral fire and smoke-sealing foam membrane for sealing individual cable penetrations through framed wall assemblies.

1. Specified Technologies Inc. (STI) EZ-Firestop Grommets.
2. Hilti

F. Fire-Rated Cable Re-Enterable Pathways: Device modules comprised of steel pathways with self-adjusting intumescent foam pads or fabric rings allowing 0 to 100 percent cable fill. The following products are acceptable:

1. Specified Technologies Inc. (STI) EZ-PATH Fire Rated Pathway.
2. Hilti Speed Sleeve

G. Smoke and Acoustical Pathways: Device module comprised of a nonmetallic pathway with integral self-adjusting smoke and sound sealing system for cable penetrations through a non-fire resistance rated wall or floor assemblies. The following products are acceptable:

1. Specified Technologies Inc. (STI) EZ-PATH Smoke & Acoustical Pathway.
2. Hilti

H. Protective Wrap: Endothermic Wrap incorporating foil scrim for protection of cable pathways, through-penetration, and membrane-penetration fire stopping, Electrical Metallic Tubing (EMT), Rigid Metallic Conduit (RMC), or Cable Trays. The following products are acceptable:

1. Specified Technologies, Inc. (STI) E-Wrap™ Endothermic Wrap
2. Hilti

PART 3 - EXECUTION

3.1 TESTING

A. Refer to Section 270000 for additional requirements.

3.2 TRAINING

A. Refer to Section 270000 for additional requirements.

3.3 WARRANTY

A. Refer to Section 270000 for additional requirements.

3.4 INSTALLATION

A. Install systems in accordance with Performance Criteria and in accordance with the conditions of testing and classification as specified or required.

B. Comply with manufacturer’s instructions for installation of products.

C. Place system stickers on each side of the wall penetrations.

D. Place a reproduction (photocopy) of the UL System description in a document protector and mount to the wall next to the wall penetration. Highlight the section of the system description that list the allowed cable types.

E. Do not install products when ambient or substrate temperatures are outside the limitations recommended by the manufacturer.

F. Do not install products when substrates are wet due to rain, frost, condensation, or other causes.

G. Do not use materials that contain flammable solvents.

H. Coordinate construction of openings and penetrating items to ensure that through-penetration firestop systems are installed according to requirements.

I. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate through-penetration firestop systems.

3.5 SCHEDULES

Penetrant Type	Concrete Floor	Concrete Wall	Gypsum Board Wall
Blank Opening	C-AJ-0100, C-AJ-0101, C-AJ-0113, C-AJ-0116	C-AJ-0100, C-AJ-0101, C-AJ-0113, C-AJ-0116	W-L-0020, W-L-0034
Metal Conduits	C-AJ-1080, C-AJ-1240, C-AJ-1353	C-AJ-1080, W-J-1098, W-J-1100	W-L-1049, W-L-1222, W-L-1168
Plastic Conduits and Raceways	C-AJ-2140, C-AJ-2292, F-A-2186, F-A-2210, F-A-2225	C-AJ-2038, C-AJ-2108, C-AJ-2578, C-AJ-2586, W-J-2018, W-J-2076	W-L-2059, W-L-2074, W-L-2093, W-L-2241
Cables	C-AJ-3214, C-AJ-3231, F-A-3015, F-A-3021, F-A-3054	C-AJ-3214, C-AJ-3231, W-J-3098, W-J-3099,W-J-3124, W-J-3150, W-J-3180	W-L-3219, W-L-3248, W-L-3287, W-L-3356, W-L-3377, W-L-3378, W-L-3379, W-L-3390
Cable Trays	C-AJ-3317, C-AJ-8181, C-AJ-4029, F-A-3015, F-A-3037	C-AJ-8181, W-J-4021, W-J-4022, W-J-4033, W-J-3098, W-J-3145, W-J-3158	W-L-3218, W-L-3271, W-L-3286, W-L-3306, W-L-4008, W-L-4029, W-L-4043, W-L-8073

END OF SECTION 270537

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SECTION 271100 - COMMUNICATIONS EQUIPMENT ROOMS

PART 1 - GENERAL

1.1 SCOPE

A. Refer to Section 270000 for additional project scope information.

B. This section describes the products and execution requirements relating to telecommunications cabling, termination components, racks, pathways, telecommunication rooms, and related subsystems. Covered systems include the following:

1. Equipment room cable management system and equipment racks
2. Horizontal and backbone cable terminating equipment
3. Telecommunications grounds and related components

1.2 RELATED WORK

A. Section 270000 – General Technology Requirements

B. Section 270500 – Communications General Requirements

C. Section 270526 – Grounding and Bonding for Technology Systems

D. Section 270528 – Pathways for Technology Systems

E. Section 270537 – Firestopping for Technology Systems

F. Section 271100 – Communications Equipment Rooms

G. Section 271300 – Communications Backbone Cabling

H. Section 271500 – Communications Horizontal Cabling

I. Section 271600 – Communications Connecting Cords

J. Section 271800 – Communications Labeling and Identification

K. Section 274000 – AV/Multimedia General Requirements

L. Section 274100 – Audio Visual Systems

M. Section 275100 – Distributed Communications Systems

N. Section 276000 – Physical Security General Requirements

O. Section 276200 – Electronic Access Control System

P. Section 276400 – Video Surveillance System

Q. Section 276600 – Intrusion Detection System

1.3 DEFINITIONS

A. Refer to Section 270000 for additional definitions.

1.4 REFERENCE STANDARDS AND CODES

A. Refer to Section 270000 for additional requirements.

1.5 QUALIFICATIONS

A. Refer to Section 270000 for additional requirements.

1.6 PRE-CONSTRUCTION SUBMITTALS

A. Refer to Section 270000 for additional requirements.

1.7 CONSTRUCTION PROGRESS SUBMITTALS

A. Refer to Section 270000 for additional requirements.

1.8 CLOSEOUT SUBMITTALS

A. Refer to Section 270000 for additional requirements.

PART 2 - PRODUCTS

2.1 SUBSTITUTIONS

A. Unless noted otherwise, products in this section are intended as a basis of design and are open to substitutions per the product substitution procedures defined in Section 270000.

2.2 CATEGORY MODULAR PATCH PANELS

A. Cables shall be terminated at the telecommunication closets on patch panels incorporating Category 6, 6A jacks (non-keyed 8-pin), meeting the specifications for the telecommunications outlet detailed in the section above.

B. Patch panel configuration shall be 48 ports modular only.

C. Patch panels shall be populated as follow:

1. Ports 1 to port 36 are dedicated for Cat 6 blue cables, jacks, and patch cables.
2. Port 37 to port 48 are dedicated for Cat 6A yellow and green cables.

D. The patch panel shall exceed ANSI/TIA/EIA 568-C.2-1 Category 6 component compliance standard. All pair combinations shall be considered, with the worst-case measurement being the basis for compliance.

E. The patch panels shall be interoperable and backward compatible to lower-performing cabling systems.

F. Panels shall incorporate cable support and/or strain relief mechanisms to secure the horizontal cables at the termination block and to ensure that all manufacturers' minimum bend radius specifications are adhered to.

G. The patch panel shall have color-coded designation strips to identify the cable count.

H. Panels shall come pre-labeled to match the network switch.

I. Manufacturers:

1. Commscope

a. 24-port flat, 1RU 760207274
b. 48-port flat, 2RU 760207282

2.3 FIBER OPTIC PATCH PANELS

A. Contractor shall provide a fiber optic patch panel at each location where a fiber optic cable terminates.

B. All terminated fibers shall be mated to duplex LC couplings mounted on enclosed patch panels. Couplers shall be mounted on a panel that, in turn, snaps into the enclosure. The proposed enclosure shall be designed to accommodate a changing variety of connector types, including SC, ST, Fixed Shroud Duplex (e.g., "FDDI Connector"), Biconic, and FC, by changing panels on which connector couplings are mounted.

C. The patch panel enclosure shall be sized to accommodate the total fiber count to be installed at each location as defined in the specifications and Drawings, including those not terminated (if applicable), PLUS 50% future growth.

D. Contractor shall provide all required connector panels and connector couplings (sleeves, bulkheads, etc.) adequate to accommodate the number of fibers to be terminated.

E. Patch panels shall be designed for easy installation, front removal, and expansion of snap-in adapter panels.

F. Patch panels shall be enclosed assemblies affording protection to the cable subassemblies and to the terminated ends. The enclosures shall incorporate a hinged or retractable front cover designed to protect the connector couplings and fiber optic jumpers.

G. The patch panel's enclosure shall provide for strain relief of incoming cables and shall incorporate radius control mechanisms to limit bending of the fiber to the manufacturer's recommended minimum or 1.2," whichever is larger.

H. Access to the inside of the patch panel enclosure during installation shall be from the front and rear. Panels that require any disassembly of the cabinet to gain entry will not be accepted.

I. All patch panels shall provide protection to both the "facilities" and "user" sides of the coupling. The patch panel enclosure shall be configured to require front access only when patching. The incoming cables (backbone, riser, etc.) shall not be accessible from the patching area of the panel. The enclosure shall provide a physical barrier to access such cables.

J. Where single-mode fibers are installed, the fibers contained in these cables may be terminated either by (1) splicing of factory-terminated cable assemblies ("pigtails") or (2) use of a "fan-out" kit. In the latter approach, individual fibers are to be secured in a protective covering (such as an Aramid reinforced tube, for example) with connectors mated to the resulting assembly. In both instances, the proposed termination hardware shall incorporate a mechanism by which cable and subassemblies are secured to prevent damage. Splicing shall be by the "fusion" method. Individual splice loss shall not exceed 0.2 dB.

K. Fiber optic patch panels shall be Commscope EPX Series.

L. Singlemode LC adaptor panels shall be Commscope TeraSPEED

M. Singlemode Splice Cassettes

1. 12-fiber w/ pigtails 760221747
2. 24-fiber w/ pigtails 760221705

2.4 CABLE MANAGEMENT SYSTEM

A. The cable management system shall be used to provide a neat and efficient means for routing and protecting fiber and copper cables and patch cords on telecommunication racks and enclosures. The system shall be a complete cable management system comprising 4-post and 2-post floor mount racks, wall mount racks, equipment cabinets, and vertical and horizontal cable managers to manage cables on both the front and rear of the rack. The system shall protect network investment by maintaining system performance, controlling cable bend radius, and providing cable strain relief.

1. 2-Post Equipment Racks

a. Contractor shall provide and install 2-post adjustable equipment racks to house cable termination components (e.g., copper data and fiber optic) and network electronics (by others) as shown on the drawings. Prior to installation, Contractor shall coordinate exact placement with the Owner.

b. Rack will require plywood backing.
c. Channel uprights shall be spaced to accommodate industry standard 19" mounting and have pass-through holes with smooth edges to protect cables.
d. Rack shall be constructed of aluminum.
e. Able to support up to 1,500 pounds.
f. Rack shall be double-side drilled and tapped to accept 12-24 screws. Uprights shall also be drilled on the back to accept cable brackets, clamps, power strip(s), etc. Hole pattern on the rack front shall be per EIA/TIA specifications (5/8"-5/8"-1/2"). Hole pattern on the rear shall be at 3" intervals to accept cable brackets.
g. Rack shall be supplied with at least 24 spare screws.
h. Rack shall be supplied with a vertical ground bar and #6 AWG ground lug.
i. Manufacturers:

1) Commscope 760082479

2. Enclosed wall mount rack for unsecured IDF locations.

a. Contractor shall provide and install 18U UPS-Depth wall-mount half-height rack to house cable termination components (e.g., copper data and fiber optic) and network electronics (by others) as shown on the drawings. Prior to installation, Contractor shall coordinate exact placement with the Owner.
b. Contractor to install fire-rated plywood behind wall mounted rack.
c. Rack shall be supplied with a vertical ground bar and #6 AWG ground lug.
d. Manufacturers:

1) Eaton SRW18USDP

B. Vertical Cable Management

1. At the telecommunication rooms, vertical cable management shall be furnished and installed to adjacent racks to organize cables on the front and rear of telecommunication racks.
2. Vertical cable managers shall include components that aid in routing, managing, and organizing cable to and from equipment. Panels shall protect network equipment by controlling cable bend radius and providing cable strain relief. Panels shall be a universal design mounting to EIA 19" or 23" racks.
3. Vertical cable management system shall feature the following:

a. Open cabling section on the rear that provides easy access and routes cable bundles feeding into the back of patch panels and 1 RMU cable guide on the front designed for fanning and managing patch cords.
b. Edge-protected pass-through ports designed for easy routing of cable from front channel to back.
c. Vertical slots along the center separator to allow securing cable bundles neatly with management straps.
d. Door/cover (front only) that is easily opened from the right or left and still easily removed to allow for quick moves, adds, and changes.
e. Movable wire retainers to retain the cables during cover removal.

4. Vertical cable management at the end of rack rows shall be 6”.

5. Vertical cable management between racks shall be 10."
6. System must match the solution
7. Manufacturer

    a. CommScope

        1) 6" Vertical, Black 760244779
        2) 10" vertical, Black 760244781

2.5 HORIZONTAL CABLE MANAGEMENT

A. Horizontal cable managers shall include components that aid in routing, managing, and organizing cable to and from equipment. Panels shall protect network equipment by controlling cable bend radius and providing cable strain relief. Panels shall be a universal design mounting to EIA 19" racks and constructed of steel bases with PVC duct attached. The duct fingers shall include retaining tabs to retain the cables in place during cover removal. The covers shall be able to hinge from either side yet still be easily removed to allow for quick moves, adds, and changes.

B. The cable managers shall be provided with movable wire retainers to retain the cables during cover removal and #12-24 mounting screws. An integral strain relief bracket shall be provided on either end of the duct to allow for easy cover placement.

C. Double-Sided horizontal cable managers shall be placed above and below each patch panel.

D. Contractor shall also supply (1) per 48-port patch panel additional managers for network electronics.

E. Manufacturers:

1. Commscope

    a. 2RU Double Sided 760128850

2.6 TELECOMMUNICATION GROUND

A. The Telecommunication Contractor is responsible for providing an appropriate ground for all racks, trays, and telecommunications equipment installed by Contractor. Refer to the Grounding and Bonding for Technology Systems specification section.

2.7 LADDER RACK

A. Within each Telecommunications Room, Contractor shall provide and install a ladder rack as shown on the Project Drawings.

B. Within each Telecommunications Room with a vertical conduit riser, Contractor shall provide and install a vertical ladder rack connecting the ground conduit sleeve penetrations with the ceiling conduit sleeve penetrations.

C. Contractor shall provide all necessary labor, supervision, materials, equipment, tests, and services to install a complete ladder rack system in the telecommunications room as shown on the Drawings.

D. Specifications and Drawings are for assistance and guidance, but exact routing, locations, distances, and levels will be governed by actual field conditions.

E. All splicing assemblies shall be the bolted type using serrated flange locknuts. Hardware shall be either yellow zinc dichromate in accordance with ASTM B633 SC2 or AISI Type 304 stainless steel.

F. Cable Drop Out/Waterfall

1. Where cable bundles transition from the tray and drops into the racks/cabinets, Contractor shall provide and install a radius control device. This device shall be a waterfall or drop-out device and shall be properly sized to accommodate a cable bundle plus 20% future growth.

G. Size ladder rack as indicated on the Contract Documents 12 inches wide.

H. Accessories (connectors, splice plates…) shall be painted to match the tray finish.

I. Manufacturers:

1. Chatsworth
2. Huffman
3. Commscope

a. Ladder rack – 10’ x 12” 760085647
b. Ladder rack – 10’ x 18” 760085654
c. Rack to runway mounting kit 760084053
d. Runway butt splice kit 760083899
e. Runway joint splice kit 760084046
f. Wall support triangular bracket 12” 760084095
g. Wall support triangular bracket 18” 760084103
h. Wall rail support 6”-12” 760084145
i. Wall rail support 15”-18” 760084152
j. Runway vertical wall bracket 760084137
k. Runway rung dropout 12”760083956
l. Runway rung dropout 18”760083964

2.8 PLYWOOD

A. Contractor shall provide plywood. Plywood shall be installed on all walls within a telecommunications room and other locations, as noted.

B. Provide void-free, interior grade, fire-rated A-C grade plywood, 3/4” by 48” by 96”, or as indicated.

C. When plywood is required to be painted, the paint shall be UL 723-rated white or gray fire retardant. The plywood's rating stamp shall be exposed (not painted over) on each sheet. Plywood shall have fire calk around all edges. Provide label including paint manufacturer, date painted, UL listing, and name of Installer.

D. Plywood shall be mounted vertically starting at 22" AFF to 118" AFF and anchored to wall studs.

PART 3 - EXECUTION

3.1 TESTING

A. Refer to Section 270000 for additional requirements.

3.2 TRAINING

A. Refer to Section 270000 for additional requirements.

3.3 WARRANTY

A. Refer to Section 270000 for additional requirements.

3.4 EQUIPMENT RACK AND CABINETS

A. Prior to permanently securing racks or cabinets, Contractor shall coordinate a walk-through with the Owner to determine the exact placement of racks.

B. Contractor shall bolt the rack to the floor as recommended by the manufacturer. Multiple racks shall be joined, and the ground made common on each. Rack shall also be stabilized by extending a brace extending to the wall. Alternately, an overhead cable tray over which the cabling accesses the equipment rack(s) shall provide this function.

C. A space between the rack upright and the wall (~6") shall be planned to allow for cabling in that area. The rear of the rack shall be ~40" from the wall to allow for access by maintenance personnel. In all cases, a minimum of 40" workspace in front of the rack is also required. Locations where these guidelines cannot be followed shall be brought to the attention of the Consultant for resolution prior to installation.

D. All hardware and equipment are to be mounted at least 18" above floor level. This is to afford easy access and, in the case of the lower limit, prevent damage to the components. Positioning of hardware shall be reviewed and approved by the Consultant and Site Coordinator(s) prior to installation.

E. Equipment rack shall be equipped with cable management hardware to allow an orderly and secure routing of twisted pair cabling to the data patch panels. At a minimum, one such horizontal jumper management panel shall be placed below each fiber optic patch panel installed by Contractor. Additional jumper management panels may be required pending the installation of

other cable types on the rack. The rack shall be grounded to the telecommunications grounding backbone (TGB) using a #6 AWG (or larger) insulated stranded copper conductor (GREEN jacket).

3.5 WIRE BASKET TRAY AND LADDER RACK RUNWAY

A. Runway shall be installed in accordance with recognized industry practices to ensure that the cable tray equipment complies with the requirements of NEC, applicable portions of NFPA 70B, and NECA's "Standards of Installation" pertaining to general electrical installation practices.

B. Coordinate installation of the runway with other electrical work as necessary to properly interface installation of wire basket runway with other work.

C. Provide sufficient space encompassing runways to permit access for installing and maintaining cables.

D. Test runways to ensure electrical continuity of bonding and grounding connections and to demonstrate compliance with specified maximum grounding resistance.

END OF SECTION 271100

SECTION 271300 - COMMUNICATIONS BACKBONE CABLING

PART 1 - GENERAL

1.1 SCOPE

A. Refer to Section 270000 for additional project scope information.

B. This section describes the products and execution requirements relating to telecommunications voice, data, and video backbone cabling and termination components.

C. Contractor is to run 24-strand fiber from MDF to each IDF.

D. Backbone Cabling is the cable and hardware interconnecting telecommunication rooms (TRs), building demarcation rooms, equipment rooms, and server rooms. The backbone cabling shall consist of the following cable types:

1. 24-strand Singlemode Fiber Optic Cable

1.2 RELATED WORK

A. Section 270000 – General Technology Requirements

B. Section 270500 – Communications General Requirements

C. Section 270526 – Grounding and Bonding for Technology Systems

D. Section 270528 – Pathways for Technology Systems

E. Section 270537 – Firestopping for Technology Systems

F. Section 271100 – Communications Equipment Rooms

G. Section 271500 – Communications Horizontal Cabling

H. Section 271600 – Communications Connecting Cords

I. Section 271800 – Communications Labeling and Identification

1.3 DEFINITIONS

A. Refer to Section 270000 for additional definitions.

1.4 REFERENCE STANDARDS AND CODES

A. Refer to Section 270000 for additional requirements.

1.5 QUALIFICATIONS

A. Refer to Section 270000 for additional requirements.

1.6 PRE-CONSTRUCTION SUBMITTALS

A. Refer to Section 270000 for additional requirements.

1.7 CONSTRUCTION PROGRESS SUBMITTALS

A. Refer to Section 270000 for additional requirements.

1.8 CLOSEOUT SUBMITTALS

A. Refer to Section 270000 for additional requirements.

1.9 TEST DATA – FIBER OPTIC MEDIA

A. The test result information for each link shall be recorded in the memory of the field tester upon completion of the test.

B. The test result records saved by the tester shall be transferred into a Windows-based database utility that allows for the maintenance, inspection, and archiving of these test records. A guarantee shall be made that these results are transferred to the PC unaltered, i.e., “as saved in the tester” at the end of each test.

C. The database for the completed job shall be stored and delivered on CD-ROM. This CD-ROM shall include the software tools required to view, inspect, and print any selection of test reports.

D. A paper copy of the test results shall be provided that lists all the links that have been tested with the following summary information:

1. The identification of the link in accordance with the naming convention defined in the overall system documentation.
2. The overall Pass/Fail evaluation of the link-under-test, including the Attenuation worst-case margin (margin is defined as the difference between the measured value and the test limit value as defined in this document).
3. The date and time of the test results were saved in the memory of the tester.

E. The following general information is to be provided in the electronic database containing the test result information for each link:

1. The identification of the customer site as specified by the end user.
2. The overall Pass/Fail evaluation of the link-under-test.
3. The name of the standard selected to execute the stored test results.
4. The cable type and the value of the 'index of refraction' are used for length calculations.
5. The date and time of the test results were saved in the memory of the tester.
6. The brand name, model, and serial number of the tester.
7. The revision of the tester software and the revision of the test standards database in the tester.

F. The detailed test results data to be provided in the electronic database for each tested optical fiber shall contain the following information:

1. The identification of the link/fiber in accordance with the naming convention defined in the overall system documentation.
2.
3. The insertion loss (attenuation) is measured at each wavelength, the test limit is calculated for the corresponding wavelength, and the margin (difference between the measured attenuation and the test limit value).

G. The link length shall be reported for each optical fiber for which the test limit was calculated.

H. Contractor shall provide accurate as-built Construction Drawings at the site during construction.

I. The Drawings are to include cable routes and outlet locations. Outlet locations shall be identified by their sequential number as defined elsewhere in this document. Numbering, icons, and drawing conventions used shall be consistent throughout all documentation provided. The Owner will provide floor plans in paper and electronic (".dwg," AutoCAD rel. 2004 and ".dxf") formats on which as-built construction information can be added. These documents will be modified accordingly by Contractor to denote as-built information as defined above and returned to the Owner.

J. Contractors shall annotate the base Drawings and return them to the Consultant in hard copy (same plot size as originals) and electronic (AutoCAD rel. 2004 and ".dxf") form.

PART 2 - PRODUCTS

2.1 SUBSTITUTIONS

A. Unless noted otherwise, products in this section are intended as a basis of design and are open to substitutions per the product substitution procedures defined in Section 270000.

2.2 TIGHT-BUFFERED OPTICAL FIBER CABLES FOR INDOOR DISTRIBUTION APPLICATIONS

A. General Considerations

1. The cable shall meet the requirements of the National Electrical Code (NEC) Section 770.

2. For plenum applications, the cable shall meet applicable flame tests: ANSI/UL 910 (NFPA 262-1994).
3. Finished cables shall conform to the applicable performance requirements of Tables 8-6 and 8-7 of the Insulated Cable Consultants Association, Inc. (ICEA) *Standard for Fiber Optic Premises Distribution Cable* (ICEA S-83-596).

B. Cable Construction

1. The coated fiber shall have a layer of Teflon placed between the acrylate coating of the optical fiber and thermoplastic buffer. The diameter of the thermoplastic buffer coating shall be 900 ±50µm. The fiber coating and buffer shall be removable with commercially available stripping tools in a single pass for connectorization or splicing.
2. Cables with 2 to 24 fibers layered aramid yarns shall serve as the tensile strength member of the cable.
3. A ripcord shall be applied between the aramid yarns and the outer jacket to facilitate jacket removal.
4. The outer jacket shall be extruded over the aramid yarns for physical and environmental protection. The jacket shall be continuous and free from pinholes, splits, blisters, or other imperfections. The jacket shall have a consistent, uniform thickness. The jacket shall be smooth, as is consistent with the best commercial practice.
5. The fibers shall be stranded around a dielectric central member.
6. For cables containing 12-24 fibers, the fibers shall be arranged in two layers.
7. The central member shall be over-coated with a thermoplastic, when required, to achieve dimensional sizing to accommodate and support the 900 µm buffered fibers.
8. Cables with 24 to 60 fibers shall have unitized riser and plenum constructions.
9. The buffered fibers shall be grouped into six-fiber subunits.
10. The fibers shall be stranded around a dielectric central member in the subunit.
11. Layered aramid yarns shall serve as the tensile strength member of the subunit.
12. A ripcord may be applied between the aramid yarns and the subunit jacket to facilitate jacket removal.
13. The subunit jacket shall be extruded over the aramid yarns for physical and environmental protection. The jacket shall be continuous and free from pinholes, splits, blisters, or other imperfections. The jacket shall have a consistent, uniform thickness. The jacket shall be smooth, as is consistent with the best commercial practice.
14. The subunits shall be stranded around a dielectric central member. A ripcord shall be inserted beneath the outer jacket to facilitate jacket removal. The outer jacket shall be extruded around the subunits. The strength members shall be of a high modulus aramid yarn. The aramid yarns shall be helically stranded around the buffered fibers. Non-toxic, non-irritant talc shall be applied to the yarns to allow them to be easily separated from the fibers and the subunit jacket.

C. Outer Cable Jacket

1. The jacket shall be continuous and free from pinholes, splits, blisters, or other imperfections. The jacket shall have a consistent, uniform thickness; jackets extruded under high pressure are not acceptable. The jacket shall be smooth, as is consistent with the best commercial practice. The jacket shall provide the cable with a tough, flexible, protective coating, able to withstand stresses. The nominal thickness of the outer cable jacket shall be sufficient to provide adequate cable protection while meeting the mechanical,

flammability, and environmental test requirements of this document over the life of the cable.

2. The indoor distribution cable specified herein shall have an interlocking armor made of steel or aluminum. Provide plenum-rated cable as required.
3. The indoor distribution cable specified herein shall be non-conductive. Provide plenum-rated cable as required.
4. The color of the jacket shall match the jacket color of the optical fiber cable located inside the cable.

D. Fiber Identification

1. The individual fibers shall be color-coded for identification. The optical fiber color coding shall be in accordance with ANSITIA/EIA-598-B "Optical Fiber Cable Color Coding." The coloring material shall be stable over the temperature range of the cable, shall not be susceptible to migration, and shall not affect the transmission characteristics of the optical fibers. Color-coded buffered fibers shall not adhere to one another.
2. When buffered fibers are grouped into individual subunits, each subunit jacket shall be numbered for identification, with the exception of filler subunits where used. The number shall be repeated at regular intervals. The subunit jacket color shall be aqua for subunits containing OM3/4 multimode fibers, yellow for subunits containing single-mode fibers, and white for filler subunits.
3. The outer jacket for all-dielectric cable shall be marked with the manufacturer name or UL file number, date of manufacture, fiber type, flame rating, listing symbol, and sequential length markings every two feet. The marking shall be in contrasting color to the cable jacket. The cable jacket color shall be Aqua for cables containing OM3/4 multimode fibers and yellow for cables containing single-mode fibers.
4. Cables shall be marked with the manufacturer name, date of manufacture, fiber type, flame rating, listing symbol, and sequential length markings every two feet. The marking shall be in contrasting color to the cable jacket. The cable jacket color shall match the color of the core optical fiber cable.

E. Cable Specifications

1. Temperature Range

   a. Non-Plenum Applications: The storage temperature range for the cable on the original shipping reel shall be -40 to +70ºC. The installation/operating temperature range for riser cables shall be -20 to +70 ºC. Testing shall be in accordance with FOTP-3.
   b. Plenum Applications: The storage temperature range for the cable on the original shipping reel shall be -40 to +70ºC.The installation/operating temperature range for plenum cables shall be 0 to +70ºC. Testing shall be in accordance with FOTP-3.

2. Compressive Load Resistance

   a. When tested in accordance with FOTP-41, Compressive Loading Resistance of Fiber Optic Cables, the cable shall withstand a minimum compressive load of 89 N/cm (50 lbf/in) applied uniformly over the length of the compression plate. While under compressive load, the fiber shall not experience an attenuation change greater than 0.4 dB at 1550 nm (single mode) or greater than 0.6 dB at 1300 nm

(multimode). After the compressive load is removed, the fibers shall not experience an attenuation change greater than 0.2 dB at 1550 nm (single mode) or greater than 0.4 dB at 1300 nm (multimode).

3. Cyclic Flexing

   a. When tested in accordance with FOTP-104, Fiber Optic Cable Cyclic Flexing Test, the cable shall withstand 25 mechanical flexing cycles at a rate of 30 ± 1 cycle per minute. The fiber shall not experience an attenuation change greater than 0.2 dB at 1550 nm (single mode) or greater than 0.4 dB at 1300 nm (multimode).

4. High and Low Temperature Bend

   a. When tested in accordance with FOTP-37, Fiber Optic Cable Bend Test, Low, and High Temperature, the cable shall withstand four full turns around a mandrel at test temperatures of 0 ºC and +50 ºC. The fibers shall not experience an attenuation change greater than 0.2 dB at 1550 nm (single mode) or greater than 0.5 dB at 1300 nm (multimode).

5. Impact Resistance

   a. When tested in accordance with FOTP-25, Repeated Impact Testing of Fiber Optic Cables and Cable Assemblies, the cable shall withstand a minimum of 20 impact cycles for riser cables and 10 impact cycles for plenum cables. The fibers shall not experience an attenuation change greater than 0.2 dB at 1550 nm (single mode) or greater than 0.4 dB at 1300 nm (multimode).

6. Temperature Cycling

   a. When tested in accordance with FOTP-3, Procedure to Measure Temperature Cycling Effects on Optical Fiber, Optical Cable, and Other Passive Fiber Optic Components, the change in attenuation at extreme operational temperatures (0 to +50 ºC) shall not exceed 0.3 dB/km at 1550 nm (single mode) or 0.6 dB/km at 1300 nm (multimode). The change in attenuation is measured with respect to the baseline values measured at room temperature before temperature cycling.

   b.

7. Twist-Bend

   a. When tested in accordance with FOTP-91, Fiber Optic Cable Twist-Bend Test, a length of cable no greater than 2 meters shall withstand 10 cycles of mechanical twisting and bending around a mandrel 20 times the cable's outer diameter. The fibers shall not experience an attenuation change greater than 0.2 dB at 1550 nm (single mode) or 0.4 dB at 1300 nm (multimode).

F. Singlemode OS2

1. The single mode fiber utilized in the optical fiber cable shall meet EIA/TIA-492CAAA, Detail Specification for Class IVa Dispersion-Unshifted Singlemode Optical Fibers, and

ITU recommendation G.652, Characteristics of Singlemode Optical Fiber Cable. The cable shall meet the following specifications:

a. Core Diameter (Characterized): 8.3 µm
b. Cladding Diameter: 125. ±1.0µm
c. Core-to-Cladding Concentricity: ≤ 0.8 µm
d. Cladding Non-Circularity: ≤1.0 %
e. Coating Diameter: 245 ±10µm

2. Attenuation: The maximum attenuation shall be 0.5 dB/km at 1310 nm and 0.4 dB/km at 1550 nm.
3. Attenuation Uniformity: There shall be no point discontinuity greater than 0.10 dB at either 1310 nm or 1550 nm.
4. Attenuation at the Water Peak: The attenuation at 1383 ± 3 nm shall not exceed 2.1dB/km.
5. Cutoff Wavelength: The cabled fiber cutoff wavelength shall be ≤1260 nm.
6. IEEE 802.3z Performance: The fiber shall support laser-based Gigabit Ethernet (1GbE) operation in the 1000BASE-LX (1310 nm) operating window at 10000 m.
7. IEEE 802.3ae Performance: The fiber shall support laser-based Gigabit Ethernet (10GbE) operation in the 10000BASE-LX (1310 nm) operating window at 10000 m.
8. IEEE 802.3ba Performance: The fiber shall support laser-based Gigabit Ethernet (40/100GbE) operation in the 40000/100000BASE-LX (1310 nm) operating window at 10000 m.
9. Mode Field Diameter: The mode field diameter of the fiber shall be 9.30 ±0.50µm at 1310 nm 10.50 ±1.0µm at 1550 nm.
10. 12 Macrobend Attenuation: The attenuation due to 100 turns of fiber around a 75-± 2mm diameter mandrel shall not exceed 0.05 dB at 1310 nm and 0.10 dB at 1550 nm.
11. Zero Dispersion Wavelength (∂o): The zero-dispersion wavelength of the fiber shall be 1301.5 nm ≤ ∂o ≤ 1321.5 nm.
12. Zero Dispersion Slope (So): The zero-dispersion slope of the fiber shall be ≤0.092 ps/(nm•km).
13. Maximum Dispersion: The maximum dispersion shall be ≤ 3.2 ps/(nm•km) from 1285 nm through 1330 nm and shall be ≤18 ps/(nm•km) at 1550 nm.

G. The cable shall be manufactured by:

1. Commscope
2. General Cable

2.3 LOOSE TUBE OPTICAL FIBER CABLES FOR OUTSIDE PLANT DISTRIBUTION APPLICATIONS

A. Fiber must be Plenum indoor and outdoor armor.

B. The cable shall be all-dielectric gel-free and designed for outdoor and limited indoor use for campus backbones in lashed aerial and duct installations.

C. The cable shall be fully water-blocked using water-swellable materials.

D. The outer sheath shall be marked with the manufacturer's name, words identifying the cable type (e.g., "Optical Cable" or "Fiber Optic Cable"), year of manufacture, and sequential length markings. The actual length of the cable shall be within -0/+1% of the length markings. The marking shall be in a contrasting color to the cable jacket.

E. Temperature Range:

1. Storage: -40 to +70C (no irreversible change in attenuation)
2. Operating: -40 to +70C
3. Humidity Range: 0 to 100%

F. Maximum Tensile Strength:

1. During Installation: 2700 Newton (600 lb. force) (no irreversible change in attenuation)
2. Long Term: 890 N (200 lb. force)

G. Bending Radius:

1. During Installation: 20 times cable diameter
2. No Load: 10 times cable diameter

H. The maximum pulling tension shall be 2700 N (608 lbf) during installation (short term) and 890 N (200 lbf) long-term installed.

I. The cable shall be manufactured by:

1. Commscope
2. General Cable

J. Single Mode Optical Fiber Performance

1. Plenum indoor outdoor armor rated
2. The single-mode fiber shall be dispersion-unshifted fiber which meets the ITU-T G.652c requirements.
3. The fiber cable shall be fully capable of handling existing and legacy single-mode applications, which traditionally operate in the 1310nm and 1550nm regions.
4. The fiber cable shall be designed to handle applications that utilize the "Extended" E band, 1360-nm to 1460 nm.
5. The fiber cable shall also be designed to provide optimum performance from 1265nm to 1625nm, making it suitable for 16-channel Course Wavelength Division Multiplexing applications.
6. The fiber shall meet the following specifications:

    a. Fiber Type Single mode; doped silica core surrounded by concentric glass cladding.
    b. Core Diameter: 8-9 µm. All fibers shall be of the same nominal core diameter and profile.
    c. Cladding Diameter: 125 + 0.7 micron
    d. Core-to-Cladding Offset: < 0.5 micron
    e. Cladding Non-Circularity: < 1.0%
    f. Coating Diameter: 245 + 10 micron

g. The coating shall be mechanically strippable without damaging the optical fiber.
h. Cutoff Wavelength (cabled fiber; ccf)<1260-nm
i. Mode field diameter: 9.2+0.4 micron at 1300-nm; 10.4+0.5 micron at 1550 -nm
j. Zero Dispersion Wavelength: 1302< < 1322nm
k. Zero Dispersion Slope (S0): <0.092 ps/nm2*km
l. Fiber Attenuation:

1) 1383-nm 0.4 dB/km
2) 1550-nm 0.3 dB/km
3) The average change in attenuation at extreme operational temperatures (40 C to +70 C) shall not exceed 0.05 dB/km at 1550 nm. The magnitude of the maximum attenuation change of each individual fiber shall not be greater than 0.05 dB/km at 1550 nm.

m. Fiber Dispersion (maximum):

1) 1285-1330-nm < 3.2-ps/nm*km
2) 1625-nm < 22-ps/nm*km

n. No single-mode optical fiber shall show a point discontinuity greater than 0.03 dB at the specified wavelengths. Such a discontinuity or any discontinuity showing a reflection at that point shall be cause for rejection of that fiber by the Owner.

2.4 FIBER OPTIC CONNECTORS

A. The SM optical connector shall be LC UPC type.

B. The OSP SM optical connector shall be LC UPC type.

C. The connector ferrule shall be ceramic or glass-in-ceramic. The optical fiber within the connector ferrule shall be secured with an adhesive.

D. The attenuation per mated pair shall not exceed 0.35 dB (individual) and 0.2 dB (average). Connectors shall sustain a minimum of 200 mating cycles per EIA/TIA-455-21 without violating specifications.

E. The connector shall meet the following performance criteria:

1. Cable Retention (FOTP-6) 0.2 dB
2. Durability (FOTP-21) 0.2 dB
3. Impact (FOTP-2) 0.2 dB
4. The rmal Shock (FOTP-3) 0.2 dB
5. Humidity (FOTP-5) 0.2 dB

F. Connectors shall be field terminated and polished or fusion spliced. Mechanical, quick-connect, or index-gel-based connectors are not allowed.

G. The manufacturer for connectivity is as follows:

1. Commscope

PART 3 - EXECUTION

3.1 TESTING

A. Refer to Section 270000 for additional requirements.

B. Field Test Requirements for Fiber Optic Cabling System

1. The fibers utilized in the installed cable shall be traceable to the manufacturer. Upon request by the Owner, Contractor shall provide the cable manufacturer's test report for each reel of cable provided. These test reports shall include the manufacturers on reel attenuation test results at 850-nm and 1300-nm for each optical fiber of each reel prior to shipment from the manufacturer.
2. Factory data shall be provided upon request, showing on-the-reel bandwidth performance results as tested at the factory.
3. Every fiber optic backbone link in the installation shall be tested in accordance with the field test specifications defined by the Telecommunications Industry Association (TIA) standard ANSI/TIA/EIA-568-C or by the appropriate network application standard(s), whichever is more demanding.
4. The test shall include the representative connector performance at the connecting hardware associated with the mating of patch cords. The test does not, however, include the performance of the connector at the interface with the test equipment.
5. 100% of the installed cabling links shall be tested and shall pass the requirements of the standards mentioned above and as further detailed in this document. Any failing link shall be diagnosed and corrected at no additional cost to the Owner. The corrective action shall be followed with a new test to prove that the corrected link meets the performance requirements. The final and passing results of the tests for all links shall be provided in the test results documentation in accordance with RFP.
6. Trained technicians who have successfully attended an appropriate training program and have obtained a certificate as proof thereof shall execute the tests. These certificates may have been issued by any of the following organizations or an equivalent organization:

    a. The manufacturer of the fiber optic cable and/or the fiber optic connectors
    b. The manufacturer of the test equipment used for the field certification
    c. Training organizations authorized by BICSI

7. Field test instruments for multimode fiber cabling shall meet the requirements of ANSI/TIA/EIA-526-14-A. The light source shall meet the launch requirements of ANSI/EIA/TIA-455-50B, Method A. This launch condition can be achieved either within the field test equipment or by use of an external mandrel wrap (as described in clause 11 of ANSI/TIA/EIA-568-C.1) with a Category 1 light source.
8. Field test instruments for single-mode fiber cabling shall meet the requirements of ANSI/EIA/TIA-526-7.
9. The tester shall be within the calibration period recommended by the vendor in order to achieve the vendor-specified measurement accuracy.

10. The fiber optic launch cables and adapters shall be of high quality, and the cables shall not show excessive wear resulting from repetitive coiling and storing of the tester interface adapters.
11. The Pass or Fail condition for the link-under-test is determined by the results of the required individual tests.
12. Pass or Fail result for each parameter is determined by comparing the measured values with the specified test limits for that parameter.
13. A representative of the Owner shall be invited to witness field testing. The representative shall be notified of the start date of the testing phase five business days before testing begins.
14. A representative of the Owner will select a random sample of 5% of the installed links. The results obtained shall be compared to the data provided by the installation Contractor. If more than 2% of the sample results differ in terms of the Pass/Fail determination, the installation Contractor, under the supervision of the Owner representative, shall repeat 100% of the testing. The cost of retesting shall be borne by the installation Contractor.

C. Fiber Performance Test Parameters

1. The link attenuation shall be calculated by the following formulas specified in ANSI/TIA/EIA standard 568-B.

   a. Link Attenuation = Cable_Attn + Connector_Attn + Splice_Attn
   b. Cable_Attn (dB) = Attenuation_Coefficient (dB/km) * Length (Km)
   c. The values for the Attenuation_Coefficient are listed in the table below:

Type of Optical Fiber	Wavelength (nm)	Attenuation_Coefficient (dB/km)
Singlemode (Inside plant)	1310	0.5
	1550	0.4
Singlemode (Outside plant)	1310	0.4
	1550	0.5

   d. Connector_Attn (dB) = number_of_connector_pairs * connector_loss (dB)
   e. Maximum allowable mated connectors_loss = 0.50 dB
   f. Splice_Attn (dB) = number of splices (S) * splice_loss (dB)
   g. Maximum allowable splice_loss = 0.1 dB (when tested bidirectionally)

2. Link attenuation does not include any active devices or passive devices other than cable, connectors, and splices—i.e., it does not include such devices as optical bypass switches, couplers, repeaters, or optical amplifiers.
3. Test equipment that measures the link length and automatically calculates the link loss based on the above formulas is preferred.
4. The above link test limits attenuation are based on the use of the One Reference Jumper Method specified by ANSI/TIA/EIA-526-14A, Method B and ANSI/TIA/EIA-526-7, Method A.1. The user shall follow the procedures established by these standards or application notes to accurately conduct performance testing.
5. The backbone link (multimode/single mode) shall be tested in two directions at both operating wavelengths to account for attenuation deltas associated with wavelength.
6. Multimode backbone links shall be tested at 850 nm and 1300 nm in accordance with ANSI/EIA/TIA-526-14A.

7. Because backbone length and the potential number of splices vary depending on site conditions, the link attenuation equation shall be used to determine limit (acceptance) values.
8. Multimode backbone links are designed to be used with network applications that use laser light sources (underfilled launch conditions). However, the link attenuation equation has been based upon the use of a light source categorized as Category 1, Overfilled.
9. Singlemode backbone links shall be tested at 1310 nm and 1550 nm in accordance with ANSI/TIA/EIA-526-7, Method A.1. All single-mode links shall be certified with test tools using laser light sources at 1310 nm and 1550 nm.

3.2 TRAINING

A. Refer to Section 270000 for additional requirements.

3.3 WARRANTY

A. Refer to Section 270000 for additional requirements.

3.4 FIBER OPTIC CABLE INSTALLATION REQUIREMENTS

A. Cable slack shall be provided in each backbone fiber optic cable. This slack is exclusive of the length of fiber that is required to accommodate termination requirements and is intended to provide for cable repair and/or equipment relocation. The cable slack shall be stored in a fashion to protect it from damage and be secured in the termination enclosure or a separate enclosure designed for this purpose. Multiple cables may share a common enclosure.

B. A minimum of 15 feet of slack cable (each cable) shall be coiled and secured at each end.

END OF SECTION 271300

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SECTION 271500 - COMMUNICATIONS HORIZONTAL CABLING

PART 1 - GENERAL

1.1 SCOPE

A. This section describes the products and execution requirements relating to telecommunications voice, data, and video horizontal (station) cabling and termination components.

B. Horizontal cabling is the cabling between the work area telecommunications outlet and the telecommunications room (TR). Horizontal cabling is often referred to as “station cabling.”

C. The horizontal cabling system will consist of the following:

1. Unshielded Twisted Pair (UTP) Cable
2. Outlet Termination Modules (jacks)
3. Outlet Termination Plates
4. Above Ceiling Cable Support Systems
5. Horizontal Cable Testing Requirements
6. Cable Pathway/Sleeve Requirements

1.2 RELATED WORK

A. Section 270000 – General Technology Requirements

B. Section 270500 – Communications General Requirements

C. Section 270526 – Grounding and Bonding for Technology Systems

D. Section 270528 – Pathways for Technology Systems

E. Section 270537 – Firestopping for Technology Systems

F. Section 271100 – Communications Equipment Rooms

G. Section 271300 – Communications Backbone Cabling

H. Section 271600 – Communications Connecting Cords

I. Section 271800 – Communications Labeling and Identification

J. Section 274000 – AV/Multimedia General Requirements

K. Section 274100 – Audio Visual Systems

L. Section 275100 – Distributed Communications Systems

M. Section 276000 – Physical Security General Requirements

N. Section 276200 – Electronic Access Control System

O. Section 276400 – Video Surveillance System

P. Section 276600 – Intrusion Detection System

1.3 DEFINITIONS

A. Refer to Section 270000 for additional definitions.

1.4 REFERENCE STANDARDS AND CODES

A. Refer to Section 270000 for additional requirements.

1.5 QUALIFICATIONS

A. Refer to Section 270000 for additional requirements.

1.6 PRE-CONSTRUCTION SUBMITTALS

A. Refer to Section 270000 for additional requirements.

1.7 CONSTRUCTION PROGRESS SUBMITTALS

A. Refer to Section 270000 for additional requirements.

1.8 CLOSEOUT SUBMITTALS

A. Refer to Section 270000 for additional requirements.

PART 2 - PRODUCTS

2.1 SUBSTITUTIONS

A. Unless noted otherwise, products in this section are intended as a basis of design and are open to substitutions per the product substitution procedures defined in Section 270000.

2.2 CATEGORY 6 HORIZONTAL COPPER CABLES

A. Category 6 is for workstations and PA only.

B. All cables and equipment shall be furnished, tested, installed, and wired by Contractor.

C. All horizontal data cables shall terminate on modular patch panels in the telecommunications closet as specified on the Drawings.

D. This specification defines the requirements for commercially available high-performance Category 6 cable.

E. This cable shall be suitable for installation free-air, in building risers, in conduit, and/or in cable tray and shall carry CMP rating.

F. The cable design described herein shall exceed the transmission performance of Category 6 cables.

G. Cables shall be Underwriters Laboratory (UL) listed, comply with Article 800 (Communications Circuits) of the National Electrical Code, and meet the specifications of NEMA (low loss), UL 444, and ICEA. Conductor shall also conform to the requirements for solid annealed copper wire in accordance with ASTM B 3.

H. All cables, termination components, and support hardware shall be furnished, tested, installed, and wired by Contractor.

I. The jacket color for data cables shall be as follow.

J. Blue: Data and PA

K. IMPORTANT: Cable and termination components (jack, patch panel, wiring blocks) are specified to function as a system. The compatibility of the cable to be installed with the proposed termination components shall be recognized and documented by the termination component manufacturer.

L. Manufacturers:

1. Commscope Uniprise Ultramedia 6 UN874043014/10

2.3 CATEGORY 6A HORIZONTAL COPPER CABLES

A. Category 6a is for wireless access points (AP) and Cameras

B. All cables and equipment shall be furnished, tested, installed, and wired by Contractor.

C. All horizontal data cables shall terminate on modular patch panels in the telecommunications closet as specified on the Drawings.

D. All wireless access points shall utilize Category 6a cable unless noted otherwise.

E. This cable shall be suitable for installation free-air, in building risers, in conduit, and/or in cable tray and shall carry CMP rating.

F. The cable design described herein shall exceed the transmission performance of Category 6a cables.

G. Category 6a cables shall be bundled separately from lower Category rated cabling.

H. Cables shall be Underwriters Laboratory (UL) listed, comply with Article 800 (Communications Circuits) of the National Electrical Code, and meet the specifications of NEMA (low loss), UL 444, and ICEA. Conductor shall also conform to the requirements for solid annealed copper wire in accordance with ASTM B 3.

I. All cables, termination components, and support hardware shall be furnished, tested, installed, and wired by Contractor.

J. The jacket color for data cables shall be as follows:

1. Yellow: AP (Wireless access points) UN874050014/10
2. Green: Cameras UN874035914/10

K. IMPORTANT: Cable and termination components (jack, patch panel, wiring blocks) are specified to function as a system. The compatibility of the cable to be installed with the proposed termination components shall be recognized and documented by the termination component manufacturer.

L. Manufacturers:

1. Commscope Uniprise

2.4 INFORMATION OUTLET

A. General

1. Station cables shall each be terminated at their designated workstation location in the connector types described in the subsections below. Included are modular jacks, faceplates, and a surface-mount raceway. The combined assembly is referred to as the Standard Information Outlet (SIO). These connector assemblies shall snap into a mounting frame.
2. SIOs shall be mounted in new outlet boxes, where existing boxes are in place, on a surface mount raceway, typically in a surface raceway with a barrier, in floor mount interface boxes, or on power poles either currently owned or new.
3. The telecommunications outlet frame shall accommodate or incorporate the following:

   a. A minimum of four (4) modular jacks when installed on a wall-mounted assembly.
   b. A mechanism for adjusting the surface plate to a plumb position.

4. When multiple jacks are identified in close proximity on the Drawings, Contractor shall determine the optimum compliant configuration based on the products proposed.
5. The same orientation and positioning of jacks and connectors shall be utilized throughout the installation. Prior to installation, Contractor shall submit the proposed configuration for each SIO type for review by the Consultant.

B. Modular Jack

1. Data jacks shall be non-keyed 8-pin modular jacks.
2. Termination components shall be designed to maintain the cable's pair twists as closely as possible to the point of mechanical termination.
3. Jacks shall utilize a four-layer printed circuit board to control NEXT.
4. Jack housings shall fully encase and protect printed circuit boards and IDC fields.
5. Modular jack contacts shall accept 2500 plug insertions.
6. Modular jack contacts shall be formed flat for increased surface contact with mated plugs. These contacts shall be arranged on the PC board in two staggered arrays of four to maximize contact spacing and minimize crosstalk.
7. Modular jack contacts shall be constructed of Beryllium copper for maximum spring force and resilience.
8. Contact Plating shall be a minimum of 50 micro inches of gold in the contact area over 50 micro-inch of nickel, compliant with FCC part 68.5.
9. Jack termination shall be 110 IDC, integral to the jack housing, laid out in two arrays of four contacts.
10. Jacks shall utilize a paired punch-down sequence. Cable pairs shall be maintained up to the IDC, terminating all conductors adjacent to its pair mate to better maintain pair characteristics designed by the cable manufacturer.
11. Jacks shall utilize tin-lead plated (60% tin/40%lead) phosphor bronze 110 insulation displacement contacts.
12. Jacks shall terminate 22-26 AWG stranded or solid conductors.
13. Jacks shall terminate insulated conductors with outside diameters up to .050".
14. Jacks shall be compatible with single conductor 110 impact termination tools.
15. Jacks shall be compatible with EIA/TIA 606 color code labeling and accept snap-on icons for identification or designation of applications.
16. Jacks shall be in color as follows:

    a. Cat 6 Blue: Data and PA CC0020917/1
    b. Cat 6A Yellow: AP (Wireless access points) 760149948
    c. Cat 6A Green: Cameras 760149963

17. Jacks shall be marked as either T568A or T568B wiring.
18. Category 6 jacks shall be manufactured by:

    a. Commscope

19. Category 6a jacks shall be manufactured by:

    a. Commscope

C. Outlet Faceplates

1. Faceplates shall match the electrical outlets for material type and color.
2. Faceplates shall incorporate recessed designation strips at the top and bottom of the frame for identifying labels. Designation strips shall be fitted with clear plastic covers.
3. Any unused jack positions shall be fitted with a removable blank inserted into the opening.
4. Modular jacks shall have the capability to incorporate a dust cover that fits over and/or into the jack opening. The dust cover shall be designed to remain with the jack assembly when

the jack is in use. No damage to the jack pinning shall result from the insertion or removal of these covers. Dust covers that result in deformation of the jack pinning shall not be accepted.

5. Wall-mounted “voice only” outlets shall be installed where identified on the floor plan Drawings to accommodate wall-mounted telephone sets. The wall plate shall be of stainless-steel construction, accommodate one RJ-45 jack, mount on a standard single gang outlet box or bracket, and include mating lugs for wall phone mounting.
6. All standard information outlets and the associated jacks shall be of the same manufacturer throughout each/ building. An allowable exception, however, is the wall-mounted “voice only” outlet described above.
7. Faceplates shall be manufactured by a modular jack manufacturer.

D. Surface Mount Interface Box

1. Low-profile surface mount boxes shall incorporate recessed designation strips at the top for identifying labels. Designation strips shall be fitted with clear plastic covers.
2. The box shall feature built-in cable management for both fiber and copper applications.
3. Any unused jack positions shall be fitted with a removable blank inserted into the opening.
4. Modular jacks shall have the capability to incorporate spring-loaded shutter doors for added protection from dust and other airborne contaminants. The dust cover shall be designed to remain with the jack assembly when the jack is in use.
5. The box shall have the capability to incorporate optional magnets that can be internally mounted.
6. Surface mount box shall be manufactured by a modular jack manufacturer.

PART 3 - EXECUTION

3.1 TESTING

A. Refer to Section 270000 for additional requirements.

3.2 TWISTED PAIR TEST EQUIPMENT

A. Test equipment used under this contract shall be from a manufacturer who has a minimum of five years of experience in producing field test equipment. Manufacturers shall be ISO 9001 certified.

B. All test tools of a given type shall be from the same manufacturer and have compatible electronic results output. The test adapter cable shall be approved by the manufacturer of the test equipment. Baseline accuracy of the test equipment shall exceed TIA Level III, as indicated by independent laboratory testing.

C. Test equipment shall:

1. Be capable of certifying Category 5E, 6, and 6A permanent links.
2. Have a dynamic range of at least 100dB to minimize measurement uncertainty.
3. Be capable of storing full frequency sweep data for all tests and printing graphical color reports for all swept measurements.

4. Include S-band time domain diagnostics for NEXT and return loss.
5. Be capable of running individual NEXT, return loss, etc., measurements in addition to AutoText.
6. Include a library of cable types stored by a major manufacturer.
7. Store at least 1000 Category 5e, 6, or 6A auto tests in internal memory.

D. The measurement reference plane of the test equipment shall start immediately at the output of the test equipment interface connector. There shall not be a time domain dead zone of any distance that excludes any part of the link from the measurements.

E. The approved manufacturer of the test equipment is Fluke and JDSU/Viavi.

3.3 TRAINING

A. Refer to Section 270000 for additional requirements.

3.4 WARRANTY

A. Refer to Section 270000 for additional requirements.

3.5 STATION CABLING

A. Information outlet cables with copper media (voice & data UTP) shall be located as detailed on the Project Drawings.

B. Contractor shall utilize these documents in determining materials quantities and routing.

C. Station cables shall be run to the information outlet from the telecommunications room serving each area in conduit, free-air above the drop ceiling, in cable tray, and/or in modular furniture.

D. The maximum station cable drop length for UTP cables shall not exceed 295 feet (90 meters) in order to meet data communications performance specifications. This length is measured from the termination panel in the wiring closet to the outlet and shall include any slack required for the installation and termination. Contractor shall install station cabling in a fashion to avoid unnecessarily long runs.

E. Contractor shall verify cable lengths comply with published standards; prior to installation of any horizontal cabling, Contractor shall verify cable paths and confirm no horizontal cable will exceed 295 total feet. If it is determined that the cable will exceed 295’, Contractor shall route the cabling to another telecommunications room or determine a shorter path, so cables are under 295’. If this is not possible, Contractor shall notify the Consultant prior to installation. Failure to do this step will not result in a change order from Contractor.

F. All cables shall be installed splice-free unless otherwise specified.

G. During pulling operation, an adequate number of workers shall be present to allow cable observation at all points of duct entry and exit as well as the feed cable and operate pulling machinery.

H. Avoid abrasion and other damage to cables during installation.

I. All cables shall be free of tension at both ends. In cases where the cable shall bear some stress, Kellom grips may be used to spread the strain over a longer length of cable.

J. Where installed free-air, installation shall consider the following:

1. Cable shall run at right angles and be kept clear of other trades' work.
2. Cables shall be supported according to code, using "J-hooks" anchored to ceiling concrete, walls, piping supports, or structural steel beams.
3. Hooks shall be designed to maintain cable bend to larger than the minimum bend radius (typically 4x the cable diameter).
4. Supports shall be spaced at a maximum 4-foot interval unless limited by building construction. If cable "sag" at mid-span exceeds 6 inches, another support shall be used.

K. Cable shall never be laid directly on the ceiling grid.

L. Cables shall not be attached to existing cabling, plumbing, steam piping, ductwork, ceiling supports, or electrical or communications conduit.

M. Manufacturers' minimum bend radius specifications shall be observed in all instances. Use of plastic cable ties is not acceptable. Cable bundles shall be neatly dressed in the use of Velcro-type straps.

N. Cable sheaths shall be protected from damage from sharp edges. Where a cable passes over a sharp edge, a bushing or grommet shall be used to protect the cable.

O. A coil of one foot in each cable shall be placed in the ceiling at the last support (e.g., J-hook) before the cables enter a fishable wall, conduit, surface raceway, or box. At any location where cables are installed into movable partition walls or modular furniture via a service pole, approximately 15 feet of slack shall be left in each station cable under 250 feet in length to allow for a change in the office layout without re-cabling. These "service loops" shall be secured at the last cable support before the cable leaves the ceiling and shall be coiled from 100% to 200% of the cable recommended minimum bend radius.

P. To reduce or eliminate EMI, the following minimum separation distances from ≤480V power lines shall be adhered to:

1. Twelve (12) inches from power lines of <5-kVa
2. Eighteen (18) inches from high voltage lighting (including fluorescent)
3. Thirty-nine (39) inches from power lines of 5-kVa or greater
4. Thirty-nine (39) inches from transformers and motors

Q. All openings shall be sleeved and firestopped per prevailing code requirements upon completion of cable installation.

3.6 INFORMATION OUTLET

A. Information outlets shall be flush-mounted on wall-mounted boxes, in floor-mounted boxes, on a surface raceway, or on modular furniture.

B. Any outlets to be added where these conditions are not met shall be positioned at a height matching that of existing services or as directed otherwise by the Site Coordinator and the Consultant. Nominal height (from the finished floor to the center line of the outlet) in the new installation shall be as follows:

1. Standard Voice & Data Outlet (SIO) shall match adjacent electrical outlets.
2. Wall-Mounted Telephone Outlet (Standard Voice only) shall meet ADA requirements for both front and side reach access.

C. Contractor shall coordinate the style of the telecommunication outlets to be installed in the floor-mount boxes and surface-mount raceways with the Owner.

3.7 ELEVATOR INTERFACE

A. Contractor shall furnish and install an elevator interface box outside of the elevator equipment room.

1. Contractor shall provide an elevator telecommunications junction box located outside of the Elevator Machine Room for the interface of telecommunication cable to the elevator cab(s). This requirement complies with ANSI A17.1 code which prevents work within the Elevator Machine Room other than specific elevator work.
2. Telecommunications J-box shall include a keyed lockable door. Additionally, the J-box shall have proper punch-down blocks and data jacks suitable for terminating all cables within the J-box.
3. Contractor shall provide any voice/data cables to this enclosure as required.
4. Electronics or cables for other systems, such as security, shall not be placed within this enclosure.
5. Coordinate the exact location of the elevator security junction box with the Elevator Contractor, Architect, and Consultant, prior to installation.
6. Cables entering the elevator telecommunications J-box and elevator equipment room shall be appropriately labeled by Contractor so that the Elevator Contractor can connect the appropriate wires to the elevator controllers. Wires should be individually labeled to separate them from other elevator functions and to assist the Elevator Contractor in making proper connection points.

3.8 CABLE TERMINATION

A. At the telecommunication closet, all data and voice cables shall be positioned on termination hardware in the sequence of the outlet ID, starting with the lowest number.

B. Termination hardware (blocks and patch panels) positioning and layout will be reviewed and approved by the Consultant prior to construction. The review does not exempt Contractor from meeting any of the requirements stated in this document.

C. Cable Termination – Data/Voice UTP

1. Data/voice patch panels shall be designed and installed in a fashion to allow future station cabling to be terminated on the panel without disruption to existing connections.
2. Data patch panels shall be sized to accommodate a minimum of 20% growth in the quantity of stations relative to the initial installation.
3. At information outlets and data/voice patch panels, the installer shall ensure that the twists in each cable pair are preserved to within 0.5 inches of the termination for data/voice cables. The cable jacket shall be removed only to the extent required to make the termination.

D. Cable Termination – Fiber Optic

1. All fibers shall be terminated using the specified connector type.
2. All terminated fibers at the telecommunications closets shall be mated to couplings mounted on patch panels. Couplings shall be mounted on a panel that, in turn, snaps into the housing assembly. Any unused panel positions shall be fitted with a blank panel inhibiting access to the fiber optic cable from the front of the housing.
3. All couplings shall be fitted with a dust cap.
4. Fibers from multiple locations may share a common enclosure, but they shall be segregated on the connector panels and clearly identified. Fibers from multiple destinations may be secured in a common enclosure, provided they are clearly identified as such. Fibers from different locations shall not share a common connector panel (e.g., “insert”).
5. Slack in each fiber shall be provided to allow for future re-termination in the event of connector or fiber end-face damage. Adequate slack shall be retained to allow termination at a 30” high workbench positioned adjacent to the termination enclosure(s). A minimum of one meter (~39”) of slack shall be retained regardless of panel position relative to the potential work area.
6. If the cable is armored, Contractor shall install a plastic twist-on bushing on each end of the interlocking armored fiber to protect the cable from sharp edges of the armor.

3.9 TEST DATA – COPPER MEDIA

A. The test result records saved by the tester shall be transferred into a Windows-based database utility that allows for the maintenance, inspection, and archiving of these test records. A guarantee shall be made that these results are transferred to the PC unaltered, i.e., “as saved in the tester” at the end of each test. Comma-separated value (CSV) format is not acceptable.

B. The database for the completed job – including twisted-pair copper cabling links, if applicable – shall be stored and delivered on CD-ROM. This CD-ROM shall include the software tools required to view, inspect, and print any selection of test reports.

C. A paper copy of the test results shall be provided that lists all the links that have been tested with the following summary information:

1. The identification of the link in accordance with the naming convention defined in the overall system documentation.

2. The overall Pass/Fail evaluation of the copper channel-under-test, including the NEXT worst-case margin (margin is defined as the difference between the measured value and the test limit value).
3. The overall Pass/Fail evaluation of the fiber link-under-test, including the Attenuation worst-case margin (margin is defined as the difference between the measured value and the test limit value).
4. The date and time of the test results were saved in the memory of the tester.

3.10 COPPER STATION CABLES

A. Station cabling testing shall be from the jack at the outlet in the work area to the patch panel on which the cables are terminated.

B. Testing shall be of the permanent link. Contractor shall warrant the performance, however, based on channel performance and provide patch cords that meet channel performance criteria. All cabling not tested strictly in accordance with these procedures shall be retested at no cost to the Owner.

C. Testing shall be from the jack at the SIO to the patch panel on which the cables are terminated at the wiring hub.

D. Horizontal “station” cables shall be free of shorts within the pairs and shall be verified for continuity, pair validity and polarity, and wire map (conductor position on the modular jack). Any defective, split, or mispositioned pairs shall be identified and corrected.

E. Testing of the cabling systems rated at TIA Category 5e/6/6a and above shall be performed to confirm proper functioning and performance.

F. Testing of the transmission performance of station cables (Category 5e/6/6a) shall include the following:

1. Length
2. Attenuation
3. Pair to Pair NEXT
4. ACR
5. PSNEXT Loss
6. Return Loss
7. Pair to Pair ELFEXT Loss or ACRF
8. PSEFEXT Loss or PS-ACRF
9. Propagation Delay
10. Delay Skew
11. Return Loss

G. The maximum length of station cable shall not exceed 90 meters, which allows 10 meters for equipment and patch cables.

H. Worst-case performance at 20°C, based on a horizontal cable length of 90 meters and equipment cord length of 4 meters, shall be as follows:

1. CATEGORY 6 (Permanent LINK)

Frequency (MHz)	Insertion Loss (Maximum dB)	NEXT Loss Pair to Pair (dB)	PS-NEXT Loss (dB; Worst Case)	ELFEXT Loss Pair to Pair (dB)	PSELFEXT loss (dB)
1.0	1.9	65.0	62.0	64.2	61.2
4.0	3.5	64.1	61.8	52.1	49.1
8.0	5.0	59.4	57.0	46.1	43.1
10.0	5.5	57.8	55.5	44.2	41.2
16.0	7.0	54.6	52.2	40.1	37.1
20.0	7.8	53.1	50.7	38.2	35.2
25.0	8.8	51.5	49.1	36.2	33.2
31.25	9.8	50.0	47.5	34.3	31.3
62.5	14.1	45.1	42.7	28.3	25.3
100.0	18.0	41.8	39.3	24.2	21.2
200.0	26.1	36.9	34.3	18.2	15.2
250.0	29.5	35.3	32.7	16.2	13.2

2. CATEGORY 6a (Permanent LINK)

Frequency (MHz)	Insertion Loss (Maximum dB)	NEXT Loss Pair to Pair (dB)	PS-NEXT Loss (dB; Worst Case)	ACRF Pair to Pair (dB)	PS-ACRF (dB)
1.0	1.9	65.0	62.0	64.2	61.2
4.0	3.5	64.1	61.8	52.1	49.1
8.0	5.0	59.4	57.0	46.1	43.1
10.0	5.5	57.8	55.5	44.2	41.2
16.0	7.0	54.6	52.2	40.1	37.1
20.0	7.8	53.1	50.7	38.2	35.2
25.0	8.8	51.5	49.1	36.2	33.2
31.25	9.8	50.0	47.5	34.3	31.3
62.5	14.1	45.1	42.7	28.3	25.3
100.0	18.0	41.8	39.3	24.2	21.2
200.0	26.1	36.9	34.3	18.2	15.2
250.0	29.5	35.3	32.7	16.2	13.2
300.0	32.7	34.0	31.4	14.6	11.6
400.0	38.5	29.9	27.1	12.1	9.1
500.0	43.8	26.7	23.8	10.2	7.2

I. In the event results of the tests are not satisfactory, Contractor shall make adjustments, replacements, and changes as necessary, and shall the n repeat the test or tests that disclosed faulty or defective material, equipment, or installation method. Contractor shall make additional tests as the Consultant deems necessary at no additional expense to the Owner or Consultant.

J. All data shall indicate the worst-case result, the frequency at which it occurs, the limit at that point, and the margin. These tests shall be performed in a swept frequency manner from 1 MHz to the highest relevant frequency, using a swept frequency interval that is consistent with TIA and ISO requirements. Information shall be provided for all pairs or pair combinations and in both directions when required by the appropriate standards.

K. Cables shall be tested to the maximum frequency defined by the standards covering that performance category. Transmission Performance Testing shall be performed using a test instrument designed for testing to the specified frequencies. Test records shall verify “PASS” on each cable and display the specified parameters—comparing test values with standards-based “templates” integral to the unit.

END OF SECTION 271500

SECTION 271600 - COMMUNICATIONS CONNECTING CORDS

PART 1 - GENERAL

1.1 SCOPE

A. This section describes the products relating to high-quality Category 6, Category 6A data patch cords and fiber.

B. In this section, the term patch cords refer to the cords that connect Owner provided data network electronics to the horizontal cable infrastructure.

C. It is important that the horizontal cable system and the provided patch cords work as one complete system for guaranteed channel performance. Patch cords shall be manufactured by the same manufacturer as the jack and patch panels.

D. Contractor shall provide and deliver all cords as listed in this section. The Owner will be responsible for the installation of cords.

1.2 RELATED WORK

A. Section 270000 – General Technology Requirements

B. Section 270500 – Communications General Requirements

C. Section 270526 – Grounding and Bonding for Technology Systems

D. Section 270528 – Pathways for Technology Systems

E. Section 270537 – Firestopping for Technology Systems

F. Section 271100 – Communications Equipment Rooms

G. Section 271300 – Communications Backbone Cabling

H. Section 271500 – Communications Horizontal Cabling

I. Section 271800 – Communications Labeling and Identification

J. Section 274000 – AV/Multimedia General Requirements

K. Section 274100 – Audio Visual Systems

L. Section 275100 – Distributed Communications Systems

M. Section 276000 – Physical Security General Requirements

N. Section 276200 – Electronic Access Control System

O. Section 276400 – Video Surveillance System

P. Section 276600 – Intrusion Detection System

1.3 DEFINITIONS

A. Refer to Section 270000 for additional definitions.

1.4 REFERENCE STANDARDS AND CODES

A. Refer to Section 270000 for additional requirements.

1.5 QUALIFICATIONS

A. Refer to Section 270000 for additional requirements.

1.6 PRE-CONSTRUCTION SUBMITTALS

A. Refer to Section 270000 for additional requirements.

1.7 CONSTRUCTION PROGRESS SUBMITTALS

A. Refer to Section 270000 for additional requirements.

1.8 CLOSEOUT SUBMITTALS

A. Refer to Section 270000 for additional requirements.

PART 2 - PRODUCTS

2.1 SUBSTITUTIONS

A. Unless noted otherwise, products in this section are intended as a basis of design and are open to substitutions per the product substitution procedures defined in Section 270000.

2.2 CATEGORY 6 AND 6A PATCH CORDS

A. The Owner has the right to determine the final length of the patch cords after the contract is awarded.

B. All patch cords shall be round and consist of eight insulated 23 AWG (24 AWG for Cat 5e) stranded copper conductors, arranged in four color-coded twisted pairs within a flame retardant jacket, and be backward compatible with lower performing categories. Modular patch cords shall utilize ISO termination method that is designed to reduce and control near-end cross talk (NEXT) and far end cross talk (FEXT) without compromising signal impedance.

C. Both ends of the cord shall be equipped with modular 8-position (RJ45 style) plugs wired straight through with standards-compliant wiring. All modular plugs shall exceed FCC CFR 47-part 68 subpart F and IEC 603.7 specifications and have 50 micro inches of gold plating over nickel contacts. Cable shall be label-verifiable. Cable jackets shall be factory marked at regular intervals indicating verifying organization and performance level. Patch cords shall have color-coded insert molded strain relief boot with a latch guard to protect against snagging. Additional color coding shall be available by the use of snap-in icons.

D. Patch cords shall be wired straight through. Pin numbers shall be identical at each end and shall be paired to match T568B patch panel jack wiring per ANSI/TIA/EIA-568-B. Patch cords shall be unkeyed.

E. The manufacturer of the cords shall be the same as the manufacturer of UTP termination hardware (jacks & patch panels). Cords shall be the highest quality patch cords available by connectivity manufacturer.

F. Patch cables must be small OD in the IDF and MDF side

G. The patch cords shall match the Category rating of the jack and cable it will be connecting to.

H. Manufacturer:

1. Commscope

I. Contractor shall provide the following patch cords (refer to section 3.04 below):

Qty	Length	Notes
1	8 inches	Non-Plenum Blue Cat 6 for each workstation and PA @IDF CO166S2-0ZN008
1	8 inches	Non-Plenum Yellow Cat 6A for each Wireless Access point @IDF CO199K2-09N008
1	8 inches	Non-Plenum Green Cat 6A for each camera @IDF CO199K2-04N008
1	7 feet	Non-Plenum Blue Cat 6 for each workstation and PA UC1BBB2-0ZF007
1	7 feet	Non-Plenum Yellow Cat 6A for each Wireless Access point UC1AAA2-09F007
1	7 feet	Non-Plenum Green Cat 6 A for each camera UC1AAA2-04F007

2.3 FIBER OPTIC PATCH CORDS

A. The Owner has the right to determine the final length of the patch cords after the contract is awarded.

B. All SM fiber optic patch cords shall:

1. Be duplex 2-3mm tight buffer design with Yellow jacket.
2. Singlemode LC/UPC to LC/UPC, Fiber Patch Cord, 1.6 mm Duplex, Riser, J - Yellow, X - No breakouts
3. Have LC-LC connectors with straight-thru connectors (inner changeable polarity).
4. Have 8-9-micron OS2 core.

C. Contractor shall provide the following patch cords (for pricing purposes only; see section 3.04 below):

1. Qty Length Notes
2. 3 meter SM Non-Plenum for each connection in both ends

D. Manufacturer:

1. Commscope

a. FEWLCLC42-JXF010
b. FEWLCLC42-JXF007

PART 3 - EXECUTION

3.1 TESTING

A. Refer to Section 270000 for additional requirements.

3.2 TRAINING

A. Refer to Section 270000 for additional requirements.

3.3 WARRANTY

A. Refer to Section 270000 for additional requirements.

3.4 ORDERING AND DELIVERY

A. Prior to ordering patch cords, Contractor shall schedule a meeting with the Owner and Consultant to verify patch cord lengths, colors, and quantities.

B. Contractor shall coordinate the delivery of patch cords with the Owner. Contractor shall have a list of delivered cords and shall have the Owner sign the delivery sheet at the time of delivery.

END OF SECTION 271600

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SECTION 271800 - COMMUNICATIONS LABELING AND IDENTIFICATION

PART 1 - GENERAL

1.1 SCOPE

A. The Contractor is to provide quality labels that will be consistent with field conditions as-built.

B. Contractor is to coordinate with the Owner and Consultant the desired nomenclature of each system and component.

C. This section describes the products and execution requirements relating to the labeling of telecommunications cabling, termination components, and related subsystems. Covered systems include the following:

1. Equipment room backboards and equipment racks
2. Station cable and terminating equipment
3. Telecommunications grounds and related components

1.2 RELATED WORK

A. Section 270000 – General Technology Requirements

B. Section 270500 – Communications General Requirements

C. Section 270526 – Grounding and Bonding for Technology Systems

D. Section 270528 – Pathways for Technology Systems

E. Section 270537 – Firestopping for Technology Systems

F. Section 271100 – Communications Equipment Rooms

G. Section 271300 – Communications Backbone Cabling

H. Section 271500 – Communications Horizontal Cabling

I. Section 271600 – Communications Connecting Cords

J. Section 274000 – AV/Multimedia General Requirements

K. Section 274100 – Audio Visual Systems

L. Section 275100 – Distributed Communications Systems

M. Section 276000 – Physical Security General Requirements

N. Section 276200 – Electronic Access Control System

O. Section 276400 – Video Surveillance System

P. Section 276600 – Intrusion Detection System

1.3 DEFINITIONS

A. Refer to Section 270000 for additional definitions.

1.4 REFERENCE STANDARDS AND CODES

A. Refer to Section 270000 for additional requirements.

1.5 QUALIFICATIONS

A. Refer to Section 270000 for additional requirements.

1.6 PRE-CONSTRUCTION SUBMITTALS

A. Refer to Section 270000 for additional requirements.

1.7 CONSTRUCTION PROGRESS SUBMITTALS

A. Refer to Section 270000 for additional requirements.

1.8 CLOSEOUT SUBMITTALS

A. Refer to Section 270000 for additional requirements.

PART 2 - PRODUCTS

2.1 SUBSTITUTIONS

A. Unless noted otherwise, products in this section are intended as a basis of design and are open to substitutions per the product substitution procedures defined in Section 270000.

2.2 LABELS

A. All labels shall be permanent and machine-generated (e.g., Brady or Panduit). No handwritten or non-permanent labels shall be allowed. Labels shall be Brady “I.D. Pro” or XC-Plus or equivalent. Labeling on backboards and/or equipment racks may be pre-cut adhesive type.

B. Characters on all labels shall be black printed on a white background.

C. Label size shall be appropriate to the cable size(s), outlet faceplate layout, patch panel design, or other related equipment sizes and layouts.

D. All labels to be used on cables shall be self-laminating, white/transparent vinyl, and be wrapped around the cable sheath. The labels shall be of adequate size to accommodate the circumference of the cable being labeled and properly self-laminated over the full extent of the printed area of the label.

E. Labels used to identify inner duct carrying fiber optic cable shall be labeled with a durable yellow polyethylene tag that reads “CAUTION Fiber Optic Cable” and includes blank spaces for adding (1) fiber count and (2) destination information. An example of a compliant product is VIP Products’ “Caution Write-On Coverall Tag.”

PART 3 - EXECUTION

3.1 TESTING

A. Refer to Section 270000 for additional requirements.

3.2 TRAINING

A. Refer to Section 270000 for additional requirements.

3.3 WARRANTY

A. Refer to Section 270000 for additional requirements.

3.4 GENERAL

A. Contractor shall match the Owner’s standard labeling scheme.

B. Clean surfaces before attaching labels.

C. Install all labels firmly. Labels attached to terminating equipment, such as backboards, faceplates, 110 blocks, and patch panels, shall be installed plumb and neatly on all equipment.

3.5 LABELING OF CABLING AND TERMINATION COMPONENTS

A. Backboard and Equipment Racks

1. Backboards and equipment racks shall be labeled by Contractor identifying the telecommunication room. Additionally, equipment racks shall have an alpha character after

the room number unique to that particular communications closet. For example, TR1-A would be the first rack in TR1.

2. Character height shall be 1 inch (minimum).

B. Cabling

1. Horizontal cables shall have a machine-generated wrap-around cable label within 4" of each end of the cable. Label shall be clearly legible and meet TIA-EIA 606 standards. Character height shall be .25" (minimum).
2. Voice/data/video backbone cables shall have a machine-generated wrap-around cable label within 12" of each end of the cable. Label shall be clearly legible and meet TIA-EIA 606 standard. Character height shall be .5" (minimum).

3.6 FIBER OPTIC BACKBONE, RISER CABLES, AND TERMINATION COMPONENTS

A. All fiber optic backbone and copper (inter-building, riser, and tie) cables shall be identified AT BOTH ENDS with a designation that identifies where the opposite end of the same cable terminates (e.g., equipment room or telecommunications room I.D.). In addition, labeling of all fiber optic cables shall include the number of fibers in the cable.

B. Each fiber optic termination panel shall be clearly labeled, indicating the destination of the cable(s) and the fiber number of each fiber position. The cable identifiers are to be secured to (1) the side and (2) the front cover of the panel enclosure.

3.7 STANDARD INFORMATION OUTLET (SIO) FACEPLATES

A. All faceplates shall be clearly labeled indicating the destination of the cable(s) (telecommunication room number), the data patch panel(s) letter designation, the data port number(s) on the data patch panel(s), and the voice cable number(s).

B. Telecommunications outlets are to be labeled (1) on the cover of the assembly and (2) on each cable terminated at that location.

C. Station cables shall be labeled within two inches of the cable end.

3.8 DATA PATCH PANELS

A. All data patch panels shall be clearly labeled, indicating the telecommunication room number, the data patch panel letter designation, and the data port number on the data patch panel (ports 1 through 48). Each telecommunication room shall start with data patch panel 'A' and continue through the alphabet.

B. A data port schedule for each telecommunication room shall be created in spreadsheet format (Excel) with the telecommunication room number, data patch panel letter designations, data port numbers, and room numbers identified in the spreadsheet. In addition, for each data patch panel port, a field shall be provided in the spreadsheet for the Owner to manage the cabling

infrastructure by recording the device and any special notes pertaining to the room utilizing the data cable terminated to the port.

C. Refer to Telecommunication "T" Series Project Drawings for standard information outlet faceplate and data & voice patch panel labeling scheme requirements. A sample of the data and voice port schedules is to be provided to the Owner, in the cable record book and in electronic format (Excel spreadsheet), with final documents provided on the Project Drawings.

3.9 FIBER OPTIC CABLES AND TERMINATION COMPONENTS

A. All fiber optic cables, termination enclosures, connector panels, and splice closures shall be clearly labeled.

B. In addition, labeling of all fiber optic cables shall include the number of fibers in the cable.

C. Each fiber optic termination panel shall be clearly labeled, indicating (1) the destination(s) of the cable(s) and (2) fiber number of each fiber position. The cable identifiers are to be secured to (1) the side and (2) the front cover of the panel enclosure.

3.10 GROUND SYSTEM LABELING

A. All grounds shall be labeled as close as practical to the point of termination (for ease of access to reading the label). Labels shall be nonmetallic and include the following statement: "WARNING: If this connector or cable is loose or must be removed, please call the building telecommunications manager." Refer to ANSI/TIA/EIA 606 for additional labeling requirements.

END OF SECTION 271800

SECTION 274000 - AV/MULTIMEDIA GENERAL REQUIREMENTS

PART 1 - GENERAL

1.1 SCOPE

A. Refer to Section 270000 for additional project scope information.

B. The successful bidder shall provide, install, configure, and provide warranty service for audiovisual systems, including displays, audio/video/graphics switching, distribution systems, integrated control systems, and other equipment as described herein.

1.2 RELATED WORK

A. Section 270000 – General Technology Requirements

B. Section 270500 – Communications General Requirements

C. Section 270526 – Grounding and Bonding for Technology Systems

D. Section 270528 – Pathways for Technology Systems

E. Section 270537 – Firestopping for Technology Systems

F. Section 271500 – Communications Horizontal Cabling

G. Section 271600 – Communications Connecting Cords

H. Section 271800 – Communications Labeling and Identification

I. Section 274100 – Audio Visual Systems

1.3 REFERENCE

A. In addition to any requirements below, Contractor shall abide by requirements delineated in 270000, including but not limited to:

1. General: Definitions, reference standards, codes, qualifications, pre-construction submittals, construction progress submittals, closeout submittals, and correction period.
2. Products: Substitutions, product specifications, miscellaneous material, cables, connectors, power devices, and interface panels.
3. Execution: Coordination, testing, training, warranty, and cable management.

1.4 DEFINITIONS

A. HDCP: High-bandwidth Digital Content Protection or a security protocol designed to limit unauthorized use of protected content. Where applicable, HDCP-compliant devices shall be utilized per design specifications. Use of HDCP-compliant systems designed herein is the responsibility of the end-user and compliance with the Owner's Fair Use policies.

B. EDID, E-EDID: Extended Display Information Data, Enhanced-Extended Display Information Data or a remotely readable (read by a source) data file that resides in a display or specialized audiovisual device – commonly referred to as a "sink" – describing the capabilities of the sink to a connected source.

C. Configuration: the software and firmware programming that defines and creates the functionality, levels, presets, and settings of devices.

D. Configure: To define functionality, levels, presets, and settings of the device(s) using software and/or firmware.

E. Programmer: Contractor personnel engaged in developing the configuration of systems.

F. DSP: Digital Signal Processing, or Digital Signal Processor.

G. AEC: Acoustic Echo Cancellation.

H. Fixed Architecture: Refers to software providing fixed processing paths with adjustable processing objects in a predetermined sequence.

I. Open Architecture: Refers to software providing infinitely variable Programmer selected processing paths with adjustable processing objects arranged in any sequence deemed appropriate by the Programmer.

1.5 REFERENCE STANDARDS AND CODES

A. Giddings, G. H. Philip. *Audio Systems – Design and Installation*.
Focal Press, 1990.
Focal Press, Elsevier Inc.
30 Corporate Drive, Suite 400
Burlington, MA 01803

B. *AV Installation Handbook, Second Edition.*
InfoComm International, 2009.
11242 Waples Mill Road, Ste. 200
Fairfax, VA 22030

C. *Audiovisual Systems Performance Verification (ANSI/Infocomm 10:2013)*
InfoComm International, 2013.
11242 Waples Mill Road, Ste. 200
Fairfax, VA 22030
http://www.infocomm.org/cps/rde/xchg/infocomm/hs.xsl/35975.htm

D. *Dashboard for Controls Template, Design Reference, and Integrators Guide.*
InfoComm International.
www.infocomm.org/cps/rde/xchg/infocomm/hs.xsl/35324.htm

E. Copyright Act of 1976
U.S. Copyright Office
101 Independence Ave. S.E.
Washington, DC 20559
Phone: (202) 707-3000

1.6 QUALIFICATIONS

A. Primary AV Contractor shall have at least one (1) employee assigned to the project in a design or management role and at least one (1) employee assigned to the project in an installing technician role, holding at least one of the following certifications:

1. CTS (InfoComm International)
2. CTS-I (InfoComm International
3. CTS-D (InfoComm International)
4. EST-L2 (National Systems ContractorAssociation)

B. DSP Programmer

1. Training: Programmer shall have received manufacturer-provided and/or manufacturer-approved training in the configuration of the DSP systems being provided.
2. Certification: Programmer shall hold the highest applicable manufacturer programming certification(s) offered by the manufacturer(s) of the DSP hardware.

C. Control System Programmer

1. Training: Programmer shall have received manufacturer-provided and/or manufacturer-approved training in the configuration of the integrated control systems being provided.
2. Certification: Programmer shall hold the applicable manufacturer programming certification(s) or be an authorized independent programmer of the integrated control systems.

a. For AMX: AMX Certified Expert (ACE Programming Expert)
b. For Crestron: Crestron Certified Programmer
c. For Extron: Extron Control Professional

D. Refer to subsequent sections for section-specific qualification requirements.

1.7 Contractor shall hold appropriate Audiovisual Provider of Excellence (APEx) certification. PRE-CONSTRUCTION SUBMITTALS

A. Refer to Section 270000 for additional requirements. Structurally Mounted Elements: Including but not limited to monitors, projectors, projection screens, and loudspeakers.

B. Frequency Assignment Plans: Provide for all wireless microphones.

C. Custom Engraving: Layout and labeling/engraving of custom products, including wall plates and interconnection panels. Provide engraving detail with material and finish detail.

D. Power Distribution: Plan for distribution and switching of AC and DC power to all audiovisual devices, including sequencing order of outlets and banks. Time delay to be field configured as necessary for proper system power up and down.

E. Colors: Confirm color option selections with the Architect per location for items such as speakers, projectors, plates, etc.

F. Layouts of physical and virtual user control in graphical format. This shall include:

1. Engraved buttons and overlays
2. Machine-printed adhesive labels
3. Graphical user interfaces for touch panels or web interfaces
4. Descriptive write-up of function(s) of each button for each page.

G. Copy of manufacturer configuration software or link to manufacturer website download page for accessing configuration software.

1. Version: Submitted software shall be the identical version used to create Audio DSP configuration.

H. Integrated control system review shall be done via web conference with the Consultant.

I. Contractor shall make changes as requested by the Consultant in the pre-construction submittal review.

1.8 CONSTRUCTION PROGRESS SUBMITTALS

A. Refer to Section 270000 for additional requirements.

1.9 CLOSEOUT SUBMITTALS

A. Refer to Section 270000 for additional requirements.

B. Quick-Reference Guides: Contractor shall create a concise quick-reference guide covering normal system operation and basic troubleshooting procedures for each room/system type. Length of each quick-reference guide shall be commensurate with the information needed for successful operation, subject to Owner approval.

1. Upon Owner approval, Contractor shall provide two (2) laminated copies and one (1) digital copy for each room/system type.

C. Serial Numbers: Contractor shall provide a list of serial numbers for all supplied components with serial numbers and with a unit price greater than $99. Organize the list by room/system type.

1.10 CORRECTION PERIOD

A. Length of Period: Contractor shall offer a one-year correction period to the Owner for this system. Contractor shall repair all equipment and cabling problems at no additional cost to the Owner during the correction period.

B. Commencement: Correction period shall begin on the date of Final Acceptance.

C. Final Acceptance: shall be defined as the date at which all contract work (save for a correction period) is complete, including punch list completion & verification, closeout submittals, and written verification by the Owner is obtained by Contractor that the systems have been accepted.

D. Response: Contractor shall respond by phone within two (2) hours to calls for service or assistance from the Owner during normal business hours for the duration of the correction period.

E. On-site Response: Contractor shall respond on-site within eight (8) business hours from the time of the initial phone contact in the event that the issue cannot be resolved over the phone.

F. Equipment on Loan: Contractor shall loan equipment for any broken, defective, or non-functional equipment that cannot be repaired and returned within one week. Contractor shall provide shipping, delivery, and integration at no additional cost to the Owner. Equipment shall be comparable in size, speed, brightness, and relevant performance specifications, as determined by the Owner.

G. Projection Lamps: Projection lamps are to be warranted by Contractor for a minimum of 90 days, or the rated life expectancy of the lamp, whichever comes first.

H. Damaged Equipment: Equipment that is damaged due to intentional misuse, abuse, or negligence is not covered under this warranty; however, Contractor shall assist the Owner in putting the system back in working order in the shortest possible timeframe while charging normal service rates for labor and equipment.

1.11 OWNERSHIP

A. Property Rights: Contractor assigns to the Owner any and all intellectual property rights and applications made by Contractor or its agents or employees in connection with the performance of this contract. Contractor also acknowledges and agrees that services rendered in connection with the performance of this contract shall be “work made for hire” within the meaning of Section 201 inventions of the Copyright Law of 1976.

PART 2 - PRODUCTS

2.1 SUBSTITUTIONS

A. Unless noted otherwise, products in this section are intended as a basis of design and are open to substitutions per the product substitution procedures defined in Section 270000.

2.2 PRODUCT SPECIFICATIONS

A. Provisions: Product specifications are provided in subsequent sections to the Contractor for the appropriate configuration and/or provision of accessories, as well as for a guide to indicate key features for possible substitutions.

B. Where wireless microphone systems are specified, Contractor shall determine the optimal frequency range for final product selection and submit the Manufacturer's recommended frequency band for Owner and Consultant approval prior to ordering equipment. Contractor shall provide congruent frequency band products where like systems are specified for interoperability of components. Where three (3) or more wireless microphones are specified within the same system, Contractor shall provide and install necessary antennae distribution for optimal performance, to be submitted for Owner and Consultant approval during the pre-construction phase.

C. Interconnections: Contractor shall be responsible for providing populated, grommeted, or blank cover plates for all wall and floor box openings intended for audiovisual systems.

D. Twisted Pair (TP) Category Cabling: Contractor shall use twisted pair Category cable as recommended by the manufacturer of transmission equipment for optimal bandwidth and signal timing. Where cable type is not specified by the manufacturer, Contractor shall use shielded twisted pair Category 6 cabling. Cable type shall be detailed in pre-construction submittals with any deviations from manufacturer recommendations expressly noted.

E. Mounts: Contractor shall fabricate mounts for projectors, monitors, loudspeakers, cameras, etc., as necessary and shall modify standard mounts as required for optimal mounting configurations. Intended hardware shall be detailed in the shop drawing submittals.

1. Custom mounting configurations shall be submitted in shop drawings for review.
2. Contractor shall provide all hardware as necessary, including flanges, Unistrut, threaded pipe, column extensions, yokes, clamps, threaded rod, aircraft cable, and any other hardware required to securely mount equipment.
3. All ceiling tile penetrations shall be neatly finished with a plate, grommet, and/or escutcheon ring.

2.3 MISCELLANEOUS MATERIAL

A. Required Equipment: Contractor shall provide additional system components typically and reasonably required to make the system operational even though not specifically indicated in Drawings, Appendices, or Specifications, including, but not limited to, cable, connectors, connecting accessories, adaptors, power supplies, power strips, rack mounting adapters and shelves, cover plates and closure panels, relays and switches, remote antenna mounts, terminal blocks, and related connector and termination hardware required by but not supplied with the equipment.

B. Blank Fill Panels: Contractor shall provide blank fill panels to cover any openings in equipment racks provided under this contract, whether specified in the equipment schedules or not. Fill panels shall match the finish of the specified rack hardware.

C. Power Distribution Strips: Contractor shall provide power distribution strips as necessary for distributing power within equipment racks and consoles. Strips shall be UL listed, be securely mountable, and be appropriate for professional installation.

D. Wall Openings: Contractor shall provide blank faceplates to cover any unused openings within the project area. Faceplate type and finish to match electrical outlets in the project.

E. Input Cables: Contractor shall provide all interconnection cables shown on the project drawings, as well as end-user input cables at all locations where laptops and other user devices are intended to be connected.

F. Keys: Keys for like equipment shall be identical.

G. Wireless Transceivers: Where wireless transceivers are specified (including, but not limited to, wireless microphones, wireless assistive listening devices, etc.) Contractor shall verify the frequency band range of existing Owner wireless systems. Contractor shall provide a wireless transceiver system(s) compatible with existing equipment for interoperability.

H. Cable Sleeving:

1. Shall be black expandable sleeving, with ends neatly turned under 2", held in place either by nylon tie-wrap or heat-shrink tubing. Tie wraps, if used, shall not deform cables within the umbilical. Cables requiring sleeving include:

   a. Exposed cabling outside of wire management in console furniture.
   b. Cable umbilicals connecting to or from wall, floor, or ceiling plates consist of more than one wire.

2. Contractor shall coordinate as necessary so that all low-voltage cabling (including Ethernet) is included in a single umbilical.

2.4 POWER DEVICES

A. Refer to Section 270000 for additional requirements.

B. All large venue audio amplifiers shall be on sequenced outlets.

2.5 FIRE STOPPING MATERIALS

A. Refer to Section 270000 for additional requirements.

PART 3 - EXECUTION

3.1 EQUIPMENT

A. As required by Section 270000.

1. Safety: Contractor shall use proper structural installation techniques and maintain a minimum 5:1 safety margin.
2. Custom Mounting Finish: Custom mounting hardware shall be painted by the Contractor to match either color of the wall, ceiling, or equipment at the Consultant's discretion.

3.2 SPARE PARTS AND REMOTE CONTROLS

A. Projector lamps and filters

B. Remote controls and batteries

C. Adapters

3.3 INTERCONNECTION

A. As required by Section 270000.

1. Interpretation: Contractor shall make system interconnections as indicated on Drawings and specified herein. Contractor shall interpret Drawings using an understanding of the equipment and general system topology (both existing and future/specified). Contractor shall provide power and control lines to and from power supplies, remotely controlled equipment, and other devices even though not explicitly indicated on Drawings or listed in equipment tables.
2. Additional: Contractor shall be responsible for associated equipment signals not specifically documented in provided drawings. These include synchronizing signals, transmitting, and receiving antennas, and LAN connections to equipment provided and/or installed by Contractor.
3. Mass Notifications: Contractor shall ensure that audio systems are appropriately managed by emergency notifications so that emergency notifications are not impeded by the audio system.

3.4 CABLE MANAGEMENT

A. As required by Section 270000.

1. Above Ceiling: Cabling located above ceilings shall be tied off to and supported by ceiling supports or other structures at a minimum of eighteen (18) inches above the ceiling.
2. Not on Ceiling: Cabling shall not lie on the ceiling.
3. Wall Cabling: Cables installed in a horizontal fashion along wall surfaces shall be installed in a surface raceway approved by the Owner and Consultant.
4. Floor Cabling: Cabling placed at floor level, such as microphones, shall be installed on the floor in the shortest possible route to the nearest wall considering traffic patterns and, in an enclosure, designed for that use and offering protection from foot traffic.
5. Desk Cabling: Where a cable is installed inside desk furniture, a means of protecting the cables and holding the cabling to a fixed surface shall be installed.

6. Grommets: Holes in horizontal furniture surfaces for cable pass-through shall be provided with appropriate-sized grommets. Grommet shall be black unless otherwise specified or required.
7. Stub-ups: Where the conduit is stubbed up through the floor and exposed, Contractor shall wrap cables with black expandable sleeving and secure them at least three (3) inches below the level of the conduit top.
    a. Where conduit is stubbed up through the floor and concealed within furniture, Contractor shall install a tether comprised of aircraft cabling to limit the distance furniture may be moved away from the stubbed-up conduit. Cabling service loop exiting stubbed-up conduit and entering furniture shall be longer than the corresponding tether, providing protection against movement of furniture that would otherwise damage installed cabling.

8. Umbilicals: Exposed cable umbilicals, such as those between instructional furniture and a floor- or wall-mounted plate, shall be covered in black expandable sleeving with neatly finished ends (heat-shrink or Consultant-approved method).

3.5 CONNECTOR TERMINATION

A. As required by Section 270000.

1. Video Connectors: Video connectors (BNC, RCA, and F) shall be terminated using a crimp tool or dies designed specifically for the connectors being applied.
2. XLR Connectors: Terminate XLR type connectors wired pin 2 high, pin 3 low, and pin 1 shield.
3. UTP: UTP cable shall be terminated with appropriate crimps tools or tools specified by the manufacturer.

3.6 GROUNDING

A. Audiovisual equipment racks shall be grounded to the telecommunication grounding system with a minimum of 6 AWG grounding cables. Refer to Section 270000 for additional grounding requirements.

3.7 TESTING & INSPECTION

A. General Information: As required by Section 270000.

B. Notification: Prior to the start of testing, provide a list to the Consultant of test equipment make, model numbers, and calibration dates that will be used.

C. Testing: Contractor shall perform complete testing on the system before the inspection. Selected systems may be retested during the inspection at the Owner’s discretion.

D. Display/Output checks: Contractor shall verify that visual and audio outputs from the system are high-quality and without noticeable distortion or feedback at normal operating levels.

E. Wiring and Labeling: Contractor shall check all inputs and outputs for correct wiring and labeling.

F. Loudspeakers: Contractor shall measure the impedance of each speaker line leaving the equipment racks. For full-range devices, use a frequency of 1000 Hz. For band-limited devices, use a frequency appropriate for the operating range of the transducer. When documenting results, Contractor shall include the calculated impedance based on the number of units on a line and the size and distance of the run. Contractor shall correct any field readings that differ more than 20% from the calculated impedance. Contractor shall use an electronic polarity checker to test each reinforcement speaker. Speakers shall have the same relative polarity.

3.8 COMPUTER GRAPHICS

A. Computer graphics shall be crisp and focused with respect to color alignment. If color alignment is not registered properly, Contractor shall identify the source of the problem and correct it. EDID and other auto-registration features shall be set within AV equipment where required for optimal system performance.

3.9 TRAINING

A. General Information: As required by Section 270000 and the following section(s).

B. Coordination and Personnel: Training shall be coordinated with the Owner’s schedule, and Contractor personnel who provide training are subject to the Owner’s approval.

3.10 PROJECT CLOSEOUT

A. Completion: System shall be considered complete when all of the following have occurred:

1. Testing has been completed to the satisfaction of the Owner and Consultant.
2. Punch-listed items have been addressed to the satisfaction of the Owner.
3. As-built drawings and system documentation has been turned over to the Owner and Consultant.
4. Complete operational training has been conducted with the Owner’s staff.
5. System Commissioning Process has been completed.

B. Acceptance: Contractor shall secure written Acceptance of systems in the form of an authorized Owner signature on the Acceptance Document. This shall constitute the Date of Acceptance.

END OF SECTION 274000

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SECTION 274100 - AUDIO VISUAL SYSTEMS

PART 1 - GENERAL

1.1 SCOPE

A. Refer to Section 270000 for additional project scope information.

B. Provide audio-visual systems as well as training and warranty services for those systems as described herein.

C. Existing systems/devices being demolished to be returned to owner for first right of refusal.

1.2 RELATED WORK

A. Section 270000 – General Technology Requirements

B. Section 270500 – Communications General Requirements

C. Section 270526 – Grounding and Bonding for Technology Systems

D. Section 270528 – Pathways for Technology Systems

E. Section 270537 – Firestopping for Technology Systems

F. Section 271500 – Communications Horizontal Cabling

G. Section 271600 – Communications Connecting Cords

H. Section 271800 – Communications Labeling and Identification

I. Section 274000 – AV/Multimedia General Requirements

1.3 REFERENCE

A. In addition to any requirements below, Contractor shall abide by requirements delineated in 270000 and 274000, including but not limited to:

1. General: Definitions, reference standards, codes, qualifications, pre-construction submittals, construction progress submittals, closeout submittals, and correction period.
2. Products: Substitutions, product specifications, miscellaneous material, cables, connectors, power devices, and interface panels.
3. Execution: Coordination, testing, training, warranty, and cable management.

1.4 CORRECTION PERIOD

A. General Information: Products shall be covered by Contractor correction period as required by Sections 270000 and 274000.

B. Correction Period: Contractor's obligation for the correction period shall not abrogate manufacturers' warranty periods.

C. Commencement: Correction Period begins on the Date of Acceptance.

1.5 SUBSTITUTIONS

A. Unless noted otherwise, products in this section are intended as a basis of design and are open to substitutions per the product substitution procedures defined in Section 270000.

1.6 OWNERSHIP

A. General: Upon completion of the project, all programming and configuration of control hardware, touch panels, and other devices shall be the property of the Owner.

B. Property Rights: Contractor assigns to the Owner any and all intellectual property rights and applications made by Contractor or its agents or employees in connection with the performance of this contract. Contractor also acknowledges and agrees that services rendered in connection with the performance of this contract shall be "work made for hire" within the meaning of Section 201 inventions of the Copyright Law of 1976.

C. No Passwords: Contractor shall not use any passwords to prevent access to code files except as specified herein.

1.7 TURN-OVER CABLES

A. Contractor shall provide an end-user input cable for every wall plate connection or other end-user input location.

B. Turn-over cables shall match the quality and requirements of the main cable run for that signal type; refer to 274000.

C. Turn-over cables shall be 10-feet in length except where noted otherwise or where required for system functionality.

1.8 MANUFACTURER COORDINATION

A. Contractor shall contact the manufacturer(s) to obtain master quote information if available. Master quotes often contain additional products that may not explicitly appear in the specifications.

1.9 SYSTEM DESCRIPTIONS

A. General

1. This specification is intended to describe the general system types/locations and components, not every connection or room. The technology drawings more fully describe these systems and must be reviewed thoroughly in conjunction with the specification.
2. The technology floor plans indicate AV device locations, including input plates, speakers, projectors, flat panel displays, wall controllers, AV cabinets, etc.
3. The technology schematics (located on the “Technology Details” drawing sheets) indicate AV components in each system type and how they are connected. The components are described generally (ex: “AMPLIFIER”) with the specified model indicated below. Some device model numbers are not indicated in these written AV specifications and must be found on the technology drawing schematics located in the detail sheets. The schematics also indicate specific installation and functional requirements not shown elsewhere.
4. The loudspeaker schedule (located on the “Technology Details” drawing sheets) indicates speaker models and other requirements. It specifies which model speaker shall be provided at each location type by using numbered identifiers that appear on the symbols on the floorplans (ex: “S1” for speaker type 1).
5. The display schedule (located on the “Technology Details” drawing sheets) indicates the anticipated display size for a given location, as well as the intended use and a reference to the associated AV schematic drawing. For example, “FP1” will be defined here to tell you the purpose, size, height, and associated AV system detail that applies anywhere you see an “FP1” symbol on the floor plans. Be aware that a room’s name on the architectural floor plans may not match the system name for the space. Use the flat panel numbers to determine what system is required.
6. Each system description includes a list of anticipated equipment. This list generally describes the type and quantity of major components. For detailed specification requirements regarding these components, refer to Part 2 as well as the AV schematic line drawings. Interconnecting cables are generally not listed as “major components” but are required and assumed to be included.

B. [System 1] Outdoor Gym

C. [System 2] Cafeteria

PART 2 - PRODUCTS

2.1 ASSISTIVE LISTENING SYSTEMS

A. Assistive listening systems shall include a stationary transmitter (and antenna distribution if needed) with receivers, earphones, neck loops, and signage.

B. Provide all components necessary to meet ADA / IBC and local code requirements for the space. Quantity of receivers, earphones, and neck loops shall be calculated to meet ADA / IBC formulas.

C. In addition to ADA-required components, provide locking carrying cases with charging bases and rechargeable batteries to match the number of receivers.

D. Technology:

1. IR – Provide an infrared system in smaller spaces where information being shared is secret or confidential and in buildings where there are many such systems and not enough RF spectrum for the channel count.
2. RF – Provide a radio frequency system (72 MHz or 216 MHz) in locations where a large coverage area is needed, and information being shared is not expected to be secret or confidential.
3. Wi-Fi – Provide a Wi-Fi/network system as a secondary solution in all spaces with assistive listening

E. Manufacturers: Listen Technologies, Williams Sound, or equal

2.2 AUDIO AMPLIFIERS

A. Amplifiers shall be sized to match the speaker manufacturer’s recommended amplifier power plus 20% additional headroom

B. Large venue systems

1. Rack-mountable, 2 RU
2. Network capable with internal DSP
3. 2-ohm, 4-ohm, 8 ohm, and 70v operation
4. Manufacturers: QSC CX-Q Series

C. Small systems

1. Rack-mountable, 1 RU half rack width
2. High-efficiency class D amplifier
3. ENERGY STAR qualified
4. 4-ohm, 8 ohm, and 70V operation
5. Minimum of 300 watts total, with an option for single bridged output or 2-channel or 4-channel operation
6. Manufacturers:

a. Crestron AMP-X300
b. Extron XPA U 1004 SB or XPA U 2002 SB
c. QSC SPA4-100 or SPA2-200

D. Smaller systems with paging override

1. Plenum rated
2. 50 watts @ 4 ohms
3. Three mixable inputs
4. Stereo or mono bridgeable speaker outputs
5. P/A override with 25V-100V sensing
6. Green sleep mode
7. Manufacturers: Roemtech PMA-350H

2.3 AV NETWORK SWITCHES

A. Provide network switches for AV systems, as necessary.

B. Switches shall be sized to match the number of connections and PoE/PoE+ load.

C. For AV systems where the AV manufacturer publishes a list of recommended or approved switches, the network switches must be on this list. For AV systems where the AV manufacturer does not publish a list, the network switches must meet the minimum specifications required by the AV equipment and recommended by the manufacturers.

2.4 AV-OVER-IP SYSTEM

A. Provide models as required by location/function

B. Manufacturers:

1. Crestron DM NVX Series
2. Extron NAV Series

2.5 BLUETOOTH EXTENDER PLATES

A. Single-gang, Decora style in-wall Bluetooth audio interface

B. One button pairing/connect with LED indicator

C. Serial control protocol for integration with control system

D. Defeatable pairing button for restricted-use applications with control system

E. Balanced mono/stereo analog outputs

F. Compatible with smartphones, Apple iPads, and Android tablets

G. Manufacturer: QSC unBT2A kit

2.6 CABLE

A. Cable shall be provided and installed as detailed herein. Cable installed that does not conform to these standards or that has not been given prior approval by the Consultant shall be removed by Contractor and replaced at Contractor's sole expense.

B. Plenum: Plenum-rated cables shall be used where required by code or by best practices. All cables running beneath raised floor shall be plenum-rated.

C. High-Definition Digital Video (HDMI)

1. Due to HDMI distance limitations, anywhere the cable distance exceeds 20 feet, an acceptable solution shall include some form of extension. Extension shall be via UTP/XTP extenders. Contractor shall provide extenders where cables exceed 20 feet, regardless of whether they are explicitly shown or specified. At locations where the end-to-end cable distance is 20 feet or less, commercial-grade passive HDMI cables may be used. Provide a cable channel that is reliable and functions with all source devices the Owner may use.
2. Acceptable solution shall support HDMI 2.0a and 4K@60Hz 4:4:4
3. Acceptable solution shall be manufactured by a Pro AV manufacturer with 5+ years in the AV industry and an existing install base in the region.
4. Manufacturers:

    a. Atlona
    b. Broadata
    c. Crestron
    d. Extron
    e. Liberty AV

D. USB

1. Due to USB distance limitations, anywhere the cable is routed within the wall or above the ceiling, an acceptable solution shall include some form of extension. Extension shall be via UTP/XTP extenders. Contractor shall provide extenders where cables route through walls or ceilings regardless of whether they are explicitly shown or specified.
2. Acceptable solution shall support at a minimum USB 2.0 except where noted otherwise.
3. Acceptable solution shall be manufactured by a Pro AV manufacturer with 5+ years in the AV industry and an existing install base in the region.
4. Manufacturers:

    a. Atlona
    b. Broadata
    c. Crestron
    d. Extron
    e. Liberty AV

E. Installed Video: Video signal coaxial cables shall have #18 solid copper center conductor, gas-injected high-density Polyethylene or Fluorinated Ethylene Propylene insulation, copper braid

shield of at least 95% coverage and 100% dual-sided foil, and black PVC jacket unless a color is otherwise noted. Cable shall be designed as a low-loss serial digital video cable. Belden 1694A, WestPenn 6350, Canare L-5CFB, Liberty 18-CMR-SD, or equal. Plenum cable, Belden 1695A, WestPenn 256350, Liberty 18-CMP-VID-COAX, or equal.

F. Flexible Video: Short video cables that are intended to be moved or adjusted on a regular, frequent basis may be constructed of a stranded bare copper center conductor RG-59/equivalent cable with >94% copper braid shield and polyethylene dielectric. Canare LV-61S, Belden 1505A, WestPenn 819, or equal. Plenum cable, Belden 1506A, WestPenn 25819, or equal.

G. High Resolution RGBHV Graphics/Video: Cable type and size shall be selected to provide a minimum of 250 MHz bandwidth (-3dB) over the length of each RGBHV signal path from source to display, including losses and gains through cable loss, signal processing, switching, and distribution equipment. Manufacturer shall designate cable as suitable for high-resolution use. Extron MHR-5, Liberty RGB5C-25-CM, or equal. Plenum cable, Extron MHR-5P, Liberty RGB5C-25-CMP, or equal.

H. Installed Line Level and Microphone (single line): Audio signal cable shall have twisted pair #22 stranded tinned copper conductors, polyethylene conductor insulation, aluminum-polyester foil shield, #24 stranded tinned copper drain wire, and chrome PVC jacket. Belden 8761, West Penn 291, Canare L-2T2S, Liberty 24-2P-STAR, or equal. Plenum cable, Belden 88761 or equal.

I. Portable Microphone, Enclosure, and Breakout Line Level Audio: Cable shall have 4 conductors per channel arranged in star quad double-balanced pairing, #24 stranded conductors of at least 40 tinned annealed copper wires, 100% coverage wrap shield, tinned copper braid shield of approximately 50% coverage, uniformly round form, and black PVC jacket. Canare L-4E6S, Belden 8723, WestPenn 355, or equal. Plenum Cable, Belden 88723, Liberty 24-4P-PLCSH-WHT, or equal.

J. Broadband Video Antenna Cable: For runs shorter than 15’, RG-59. For runs 15’-50’, RG-6.

K. Wireless Microphone Antenna Extension Cable: 50-Ohm coaxial cable or as directed by the microphone manufacturer.

L. Loudspeaker Wire: 14 AWG minimum.

M. UTP Cable: Shall be consistent with specific recommendations by the hardware manufacturer of transmission equipment. Where no clear recommendation is made, the cable shall, at a minimum, meet the Category 6 performance requirements outlined in 271500.

N. Control: Shall be as recommended by the equipment manufacturer, with the appropriate number of conductors for the application.

O. Cable Construction: Contractor shall fabricate interconnecting cables using products defined in this section unless the equipment manufacturer-provided cable is of a specialized or proprietary nature. Pre-manufactured cables are subject to prior approval by the Consultant.

P. Labels: Labels shall include a white paper or vinyl slip with typed or machine-printed designations, secured in place with a wider section of clear heat shrink tubing or integral clear adhesive-backed plastic.

Q. Terminations: Provide specialized terminating hardware as required.

R. Schedule: Contractor shall submit a schedule prior to installation for Consultant review indicating cable types that will be used on the project

2.7 CAMERA SYSTEMS

A. Pan/Tilt/Zoom (PTZ) Cameras

1. Wide-angle PTZ camera, at least 74-degree horizontal field of view, with 1080p/60Hz resolution
2. Ethernet network solution with the ability to integrate multiple cameras and Dante audio in a single system
3. USB user interfaces with Dante audio to bring camera video and separate Dante microphone audio into a computer over a single USB cable for distance learning, recording, and conferencing applications.
4. Confirm exact camera locations and intended views with the Consultant and Owner prior to installation.
5. Manufacturer: Vaddio EasyIP 10 camera with EasyIP Mixer and AV network switch

B. Auto-Tracking Cameras

1. Manufacturer: Vaddio IntelliSHOT with USB 3.0 cable extension

2.8 CEILING ENCLOSURE BOX

A. Certain locations noted on plans shall receive a large flush-mount ceiling box that replaces a 2’x2’ ceiling tile. This box shall function as a centralized location for display connectivity (data, power, AV) as well as a space to house any electronics feeding or controlling the display.

B. The ceiling box shall include knockouts where single-gang boxes can be attached on at least three sides.

C. Contractor shall be responsible for proposing an enclosure that accommodates all anticipated equipment and includes sufficient passive or active ventilation for the heat load generated.

D. Manufacturers: Chief, FSR, Legrand Wiremold, Premier Mounts,

1. FSR CB-224S – provided at any location where a single component is greater than 1 RU or where the sum of the components is greater than 2 RU

2.9 CONFERENCING SYSTEM

A. All-in-one soundbar

1. Conferencing soundbar with a speaker, camera, and microphone in a single enclosure and one USB connector.

2. Single USB 3.0 interface
3. Built-in 180-degree far-field microphone array
4. Built-in intelligent 1080p video camera with digital autozoom and auto framing
5. High-powered 2-way stereo speakers
6. Manufacturer: Crestron UC-SB1-CAM

B. Conference room kit

1. Manufacturer: Logitech Rally & Rally Plus kit solutions

2.10 CONNECTORS

A. Connectors shall be provided and installed as detailed herein. Connectors installed that do not conform to these standards or that have not been given prior approval by the Consultant shall be removed by Contractor and replaced at Contractor's sole expense.

B. HDMI (Video/Audio/Control): Cables to be factory-terminated with molded strain relief.

C. BNC (Video): Video signal BNC connectors shall be 3-piece crimp-on type with insertion barrel, ferrule, and gold flashed crimp-on center pin. Barrel shall provide full circumferential contact with the braid. Fittings shall be sized to fit the cable. Canare BCP-C series or equal. Crimping and die tools shall be Canare TC-1 Hand Crimp Tool with appropriate TCD die sets or equal.

D. RCA (Video): Video signal RCA connectors shall be 3-piece crimp-on type with gold flashed center pin, Canare RCAP-C series or equal. Crimping and die tools shall be Canare TC-1 Hand Crimp Tool with appropriate TCD die sets or equal.

E. F (Video): Video signal F connectors shall be 3-piece crimp-on type with gold flashed crimp-on center pin. Canare FP-C series or equal. Crimping and die tools shall be Canare TC-1 Hand Crimp Tool with appropriate TCD die sets or equal.

F. BNC (RGBHV Graphics): Graphics signal BNC connector shall be a crimp-on type with an insertion barrel, ferrule, and gold flashed crimp-on center pin. Barrel shall provide full circumferential contact with the braid. Fittings shall be sized to fit the cable. BNC manufacturer, model, and tools as recommended by the manufacturer of the RGBHV/graphics cable.

G. XLR: Strain relief shall be sized to fit the cable. Connector shell shall be isolated from all contacts. Neutrik CA-NC series or equal.

H. Mini-XLR: Strain relief shall be sized to fit the cable. Connector shell shall be isolated from all contacts. Switchcraft or equivalent.

I. Phono (RCA): Phono/RCA connectors shall have gold contact and a solid center pin with metal strain relief. Canare F-10 or Canare F-09 or equal.

J. Phone (1/4 inch): Reinforced one-piece body shall have a brass bar running the length of the handle. Canare F-15 (TS) or Canare F-16 (TRS) or equal.

K. Mini (1/8 inch): Shall be Canare F-11 (TS) or Canare F-12 (TRS) or equal.

L. RJ45: RJ45 jacks that are field-terminated shall be punch-down type. All flexible connectivity to AV devices shall be factory-molded patch cables. Where a field-terminated plug is required by manufacturer recommendations, Contractor shall use the appropriate connector type to the type of cable used (solid vs. stranded).

M. Shielded cable is to be terminated with shielded connectors or as required by manufacturer recommendations.

N. DM, DM8G+: Shall be Crestron shielded RJ-45 and fiber connectors, as recommended by the manufacturer of DM or DM8G+ system.

O. Schedule: Contractor shall submit a schedule prior to installation for Consultant review indicating connectors that will be used on the project.

2.11 CONTROL SYSTEMS

A. Control system processor with the ability to control all major system components and functions within a given room, including items such as flat panel displays, media players, projectors, projection screens, presentation switcher, digital mixer, digital signal processors, power sequencers, etc.

B. Control system may be built into a presentation switcher or standalone

C. Each control system shall include a control interface. In large venues or complex spaces, this shall be a touch panel controller – 7” or 10” minimum diagonal size depending on requirements. In smaller spaces and simpler systems, this could be a keypad or button panel.

D. Control systems shall be network manageable. Contractor shall set up the manufacturer’s network interface for the Owner to use.

E. Manufacturers: Crestron, Extron, QSC,

F. Sized to fit all system equipment with space for airflow and future expansion

G. Casework/millwork locations

1. Sized to fit all system equipment with space for airflow and future expansion
2. Coordinated to fit inside of casework; refer to architectural plans

    a. Fan kit with thermostatic fan control
    b. Coordinate active cooling and ventilation with millwork Contractor
    c. Ventilation shall include passive air intake at the bottom and exhaust at the top

3. Manufacturer: Middle Atlantic SRSR Series

H. Instructor lectern locations

1. Rack shall be built into the lectern.

2. All finishes shall be coordinated with the Owner. An approved proof of concept is required prior to ordering.
3. AV Contractor shall coordinate with Architect and furniture provider to ensure the appropriate rack space and cable pathways are provided.

I. Fixed wall locations

1. Provide with:

a. 1 RU vented blank panels between all major components (e.g., amplifiers) and equipment groupings (e.g., wireless receivers, media players, etc.)
b. 4 RU rack drawer for housing microphones and cables
c. Locking vented front door
d. Quiet fan kit with thermostatic fan control

2. Manufacturers: Middle Atlantic SR-Series or equal

2.12 WIRELESS PRESENTATION DEVICE

A. Wireless presentation connectivity, with support for Windows, macOS, Android, and iOS devices, with browser-based support for Chromebook and Linux

B. App-free sharing options including AirPlay, Miracast, Browser sharing, Wired HDMI input

C. Support for touch and 4K UHD displays

D. Manufacturers:

1. Barco ClickShare
2. Crestron AirMedia
3. Extron ShareLink Pro
4. Mersive Solstice Pod

PART 3 - EXECUTION

3.1 EQUIPMENT LOCATION

A. Coordination: Where device locations are not shown on rack/console elevations and project drawings, Contractor shall coordinate with the Consultant to identify desired/optimal locations.

B. Contractor shall verify all wall-mounted monitor mounting heights on preconstruction submittals.

3.2 AESTHETIC REQUIREMENTS

A. Printing: Button labels shall be engraved where applicable or machine-printed where no engraved button/bezel is available. Handwritten labels are not acceptable.

B. Graphics: Icons and graphic representations of equipment and functions shall be crisp, sharp, and easy to identify. Icons shall be used wherever possible.

C. Text: ICS screens shall not use uncommon abbreviations. Text shall be sans serif and shall be sized to be clearly readable.

3.3 EQUIPMENT CONFIGURATION

A. Labeling: Contractor shall configure all equipment for normal use, including the setting of levels and presets. Small adhesive labels shall be affixed to equipment indicating nominal levels and settings.

B. EDID, E-EDID: Where devices allow for the customization of EDID information, Contractor shall configure EDID settings of all applicable devices such that the audiovisual system is optimized.

C. Software: Contractor shall utilize the Manufacturers current official version of configuration software. Special exemption may be obtained from the Consultant if the current version contains known issues. In such event, the version immediately preceding shall be utilized.

D. IP Interface: Contractor shall configure/modify IP-based monitoring software to allow the Owner to monitor all rooms installed as part of this work. Automatic timed system shutdown shall be configured as part of this software. Shutdown time(s) to be coordinated with the Owner.

E. Control System: Contractor shall make adjustments to programming as required by the Consultant up to the issuance of a substantial completion punch list at no additional charge, so long as changes relate to equipment in this bid package.

3.4 DIGITAL SIGNAL PROCESSOR

A. Processor power required of DSP shall not exceed 80% total processing capacity. If the processing power required exceeds the available processing power, Contractor shall immediately notify the Consultant during the pre-installation phase.

B. Functional Requirements

1. Functions: The DSP shall be configured to provide:

a. Pre-amplification
b. Filtering and Equalization
c. Dynamics processing
d. Gating
e. Mixing, Automatic mixing – gain sharing or gated
f. Zoning
g. Mix-minus
h. Delay
i. AEC
j. Volume control

k. Emergency/Alarm muting
l. Signal metering
m. Logic functions

2. Gain Structure: The DSP shall be configured to obtain and maintain unity gain structure from the input pre-amplification stage to the output stage or associated end-user volume control.
3. AEC: The DSP shall be configured to provide AEC for all microphones detecting echo in conferencing and specialty DSP applications. AEC shall be configured per DSP Manufacturer's recommendations and best practices.
4. AEC and Pre-AEC: Where microphones used for speech/sound reinforcement are part of a conferencing system requiring AEC processing, the "Pre-AEC" audio path shall be utilized for speech/sound reinforcement while a separate path processed for AEC shall be utilized for conferencing.
5. Organization: Referring to open-Architecture DSP platforms. Processing objects shall be clearly labeled and organized clearly to follow the intended signal path from left to right, top to bottom. Connection lines between objects shall be routed in an organized fashion.
6. Multiple DSP: Where designs include more than one DSP linked via a virtual multi-channel audio buss or digital audio network, all signals shall be routed to a central processor for master routing and 3rd party control. All control points being controlled by ICS controls shall be located on a single DSP operating as the master unit.
7. Latency: Also known as propagation delay, Programmer shall utilize sufficient and efficient processing paths to achieve intended results whilst minimizing latency from input to output.

C. DSP Controls

1. Contractor shall coordinate the work of ICS Programmer and DSP Programmer.
2. Volume controls shall be range limited within DSP to provide end-user with an adequate adjustment range (typically +/-6dB for microphones and +/-10dB for presentation sources). Operation of DSP from an end-user standpoint shall be seamless with ICS system operation.
3. Processing objects within Audio DSP configuration shall be clearly identified where controlled by ICS. Text objects or similar shall identify these objects.

3.5 IT COORDINATION

A. General: Where the connection between components or control features is accomplished over the Owner's LAN, Contractor shall coordinate with Owner's IT department for IP addresses, firewall access, and other issues pertaining to successful integration.

B. Permission: It is Contractor's responsibility to obtain the necessary information and permissions to implement their system. Any delays or problems with gathering information or coordinating access to the LAN or WAN shall be brought to the Consultant immediately for resolution.

3.6 SYSTEM TESTING

A. Contractor shall check that all cables are properly labeled and secured prior to substantial completion inspection.

B. Contractor shall ensure that all work areas are clear of all debris, tools, empty boxes, and extra parts prior to substantial completion inspection.

C. Prior to the substantial completion inspection, Contractor shall notify the Consultant that all items listed below are complete:

1. Contractor shall ensure that all standard functions of equipment are functional.
2. Contractor shall verify all inputs and outputs of the system for signal quality.
3. Audio: Contractor shall verify all sources are free of destructive noise (excessive noise floor, hiss, grounding interference) and that speakers function properly. The audio system shall be consistent in terms of volume and tone and shall be optimized for the space(s) served by the audio system.

    a. Control functionality, verification of presets, volume controls, mute controls, etc.
    b. Stable operation, completely free of feedback and distortion throughout the entire range of available ICS controls.
    c. Correct routing of all signals to intended destinations.
    d. Unity gain structure.
    e. Output transducer (speaker) protection processing functionality.
    f. AEC functionality.
    g. Provide measurement test results per ANSI/InfoComm 1M-2009 ACU.
    h. Outdoor sound system measurements shall be provided at a minimum of one measurement location per 50 seats. Measurements shall be performed using a pink noise test signal at a volume congruent with nominal system operation. Measurements shall indicate:

        1) Site plan map of seating areas and test locations.
        2) Frequency response from 80Hz-16kHz in 1/3 octave resolution.
        3) SPL (A-weighted) of the test signal as measured from each location.
        4) Weather conditions at the time of the test, including temperature, humidity, and average wind speeds.

4. Video: Contractor shall verify that all EDID and EDID-D information has been configured at each video transmission and processing device. Where signal processing is present, Contractor shall optimize the video system to the native resolution of display devices.

D. Immediately prior to the final inspection, in the presence of the Consultant and/or Owner representative, Contractor shall load the DSP program and integrated control system program from the Closeout Submittal media and demonstrate full system functionality.

3.7 FIRMWARE

A. Firmware upgrades shall be dated the same as the Date of Acceptance. Contractor shall upgrade firmware and software as necessary during the project so that the latest versions are installed as of the Date of Acceptance.

3.8 TRAINING

A. General Information: As required by Sections 270000 and 274000.

B. Contractor shall provide one (1) 60-minute training session for each unique audiovisual room type. Training sessions shall comprise of one half of the time dedicated to instructor-led training, with the remainder of the session to be used for the instructor-supervised hands-on end-user operation of the system(s):

1. Identification of input locations, source devices, control locations, displays, and other devices requiring end-user interaction for successful system operation.
2. Use of control system.
3. Use of source devices and input locations.
4. Switching inputs for each display.
5. Training shall include the operation of the system in the event of a control system malfunction – all manual switching and use of remotes.
6. Basic troubleshooting for common user errors.

C. Scheduling: Training shall be scheduled with the Owner at least ten (10) days in advance.

Quick-Reference Guides: Contractor shall compile a quick-reference guide for system operation and basic troubleshooting. Quick-reference guide shall be provided at the training session, and training shall include walking through quick-reference guide steps.END OF SECTION 274100

SECTION 275100 - DISTRIBUTED COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SCOPE

A. Refer to Section 270000 for additional project scope information.

B. Contractor Shall:

1. Provide Equipment, Cable, and Devices described herein or depicted in the construction drawings.
2. Provide Labor and Services necessary to integrate each piece of Equipment, Cable, and Device into a fully operational system as a Turn-Key installation without additional charges to the Owner outside the contracted amount.
3. Integrate into the construction any existing or owner furnished equipment and miscellaneous hardware as may be described herein.
4. Maintain timely installations according to the project construction schedule.
5. Provide Owner Training, Record documentation, and operations manuals.

C. Collectively Contractor delivered systems shall be as described herein and depicted in the construction drawings and provide for the following:

1. Campus wide Public-Address Communications System, with centralized master clock system and audio alert notification (bell) system as follows:
2. Minimum of Ten (10) Independent Hall audio channels (zones)

    a. Zone 1 Admin-Offices
    b. Zone 2 Shop
    c. Zone 3 Fuel Pumps
    d. Zone 4 Gymnasium-Athletics
    e. Zone 5 Hallways-corridors
    f. Zone 6 Portable Bldgs. - Spare
    g. Zone 7 Outside Speakers
    h.

3. Independent audio for each audio zone
4. IP based Web-Browser Graphical User Interface, IP Bell / Audio event scheduler, with 365-day Event Scheduling Calendar.

D. Contractor to provide for the Greenwood Forest Elementary building MDF:

a. Server VE6030-1
b. Software - IP6000
c. Will need 1 VE6090 -1 IP 6k head end
d. Will need 2 VE8004 - audio gateways

1.3 RELATED WORK

A. Work diagrammatically shown or noted on project drawings

B. Other documents that collectively make up a part of this Construction Document package

C. Section 270000 – General Technology Requirements

D. Section 270500 – Communications General Requirements

E. Section 270523 – Pathways for Technology Systems

F. Section 270526 – Grounding and Bonding for Technology Systems

G. Section 271100 – Communications Equipment Rooms

H. Section 271500 – Communications Horizontal Cabling

I. Section 271600 – Communications Connecting Cords

J. Section 271800 – Communications Labeling and Identification

K. Section 276000 – Physical Security General Requirements

L. Section 276400 – Video Surveillance System

M. Section 276600 – Intrusion Detection System

1.4 DEFINITIONS

A. Refer to Section 270000 for additional requirements.

1.5 REFERENCE STANDARDS AND CODES

A. Refer to Section 270000 for additional requirements.

1.6 QUALIFICATIONS

A. Refer to Section 270000 for additional requirements.

B. Training: Programmer shall have received manufacturer-provided and/or manufacturer-approved training in the configuration of the distributed communications system(s) being provided.

C. Certification: Programmer shall hold the highest applicable manufacturer programming certification(s) offered by the manufacturer(s) of the distributed communications system(s) hardware.

D. Submittal: Certification certificate shall be submitted with distributed communications system(s) submittals.

1.7 SUBMITTALS

A. Refer to Section 270000 for additional requirements.

1.8 CONSTRUCTION PROGRESS SUBMITTALS

A. Refer to Section 270000 for additional requirements.

1.9 CLOSEOUT SUBMITTALS

A. Refer to Section 270000 for additional requirements.

1.10 MOUNTING AND INSTALLATION

A. Provide the appropriate mounting hardware for all ceiling types and wall types where devices will be located.

B. Exterior devices shall be installed in a sealed backbox with a weather hood.

1.11 CODE AND STANDARD REQUIREMENTS

A. All work and materials shall conform in every detail to the rules and requirements of the National Fire Protection Association and any other codes as required by the AHJ.

B. All materials shall be listed by UL and shall bear the UL label. If UL has no published standards for a particular item, then other national independent testing standards shall apply, and such items shall bear those labels. Where UL has an applicable system listing and label, the entire system shall be so labeled.

C. Other applicable codes and standards are as follows:

1. ANSI/IEEE C2 – National Electrical Safety Code
2. NFPA 70 – National Electrical Code
3. TIA/EIA 568-C-1, 2, 3 Standards

PART 2 - PRODUCTS

2.1 SUBSTITUTIONS

A. Unless noted otherwise, products in this section are intended as a basis of design and are open to substitutions per the product substitution procedures defined in Section 270000.

2.2 GENERAL

A. Provide a complete and functional technology system as described herein, of high professional quality and reliability, and that meets or exceeds standards that are currently established for such systems.

B. Provide all necessary labor, materials, tools, transportation, services, ancillary items, and coordination to furnish the Owner a complete and fully functional installation as described herein.

C. The Contractor warrants that they will provide professional services, to meet or exceed performance standards and industry recommendations that relate to the scope of work under contract, and that the workmen or system installers are experienced and regularly in the business of installing such systems as specified herein.

D. All work shall be in accordance with the respective drawings, written specifications, supplemental information, industry standards, manufacturer specific installation procedure, trade practice, and applicable regulatory agencies.

E. Ancillary and Accessory Items

1. The Contractor shall provide ancillary and required accessory items necessary to furnish to the Owner a complete and fully functional system.
2. The exclusion of / or limitation in the language used in the drawings or specifications shall not be interpreted as meaning that ancillary or accessories items of work or equipment necessary to complete or make the installed system fully functional can be omitted.
3. The mention in writing or representation by depiction materials, services, or operations within this specification document and or Proposal package is binding upon the Proposer to include and provides such items, services, and operations without additional charge to Owner. Exceptions shall be noted by the acronym (NIC) “Not in Contract” or (OFE) “Owner Furnished Equipment.” If this notation does not appear, then the Proposer shall assume the need to provide the item in question.

F. Drawing Symbols

1. The project scope drawings utilize symbols and schematic block diagrams to indicate various items of work. Neither of these has any dimensional significance nor do they delineate all items that may be required for the intended construction and installation.
2. The work shall be installed in accordance with the intent diagrammatically expressed on the drawings and described in the written specifications. The Proposer shall not make limiting interpretation that provides for incomplete work or a non-functioning system.

G. Document Discrepancy

1. In the event of an inconsistency or discrepancy that may exist in or between parts of these Construction Documents, the following direction shall be followed and shall govern:

    a. The document, section, phrase, or requirement with better quality, more stringent requirement, or greater amount or quantity of work or material shall apply and shall be expected, delivered, and used. Such work or material shall be provided by the Contractor and installed at no additional cost to the Owner.

H. Omissions

1. The omission of or express reference to any part(s) necessary for a complete and fully functional system and installation as intended shall not be construed as a release from the Proposer providing and installing such parts.

2.3 MANUFACTURERS

A. Governing Clauses

1. It is not the intent of these specifications to limit or restrict submission of proposals for products or systems by manufacturers other than those specified.
2. The products specified are intended to establish a minimum baseline of operational, functional, and performance-based system expectations that all proposed products must meet or exceed by features, functionality, and quality.
3. The Owner reserves the right to govern over and proclaim whether proposed products are equal to the specified system standards.
4. If the proposed system does not meet all the features or functions described herein, then the Proposer shall identify and list those exceptions in their proposal submittal by separate cover titled “System Exceptions” in red letters.
5. The Proposer shall not be automatically disqualified for not meeting one or more requirements. The Owner shall evaluate proposals on their overall value; all proposals shall be fully considered for best value.
6. Reference to specific equipment manufacturers does not imply that all products produced by that manufacturer meet the specification requirements.

B. Acceptable Manufacturers

1. Server VE6030-1
2. Software - IP6000
3. Will need VE6090
4. Will need VE8004V
5. C6124P Power Supply
6. VC40R-4 Back Plane Cable
7. VEWRK Wall Rack & Power Harness
8. Valcom V-LPT Line Level
9. Valcom V-9022A-2 2x2 Lay In Speaker
10. Valcom V-9852 Vandal Resistant Wall-Mount Speaker
11. Valcom V-9805 Vandal Resistant Enclosure w/ SS Faceplate

12. Valcom V-1080 Flex Horn
13. Valcom VP-6124 Power Supply
14. Valcom VP-6124-UPS Power Supply UPS
15. Valcom V-1092 Volume Control the CCS PA & Bell / Audio Event System

2.4 TERMS & CONDITIONS

A. The successful Contractor providing software for this project affirms that it possesses complete and valid title and rights to furnish the said software. Further that it possesses legal right to sell, transfer, or license the software to the Owner.

B. The Successful Contractor herby agrees to protect, indemnify, and hold the Owner harmless against any and all claims, suits, or proceedings for patent, trademark, copyright, or franchise infringement arising out of, or resulting from, the installation or use of software or any part of the Contractor provided materials or equipment.

C. Provide the Owner with an installable and exact copy of each software program installed and running on any system furnished. The software delivered to the Owner shall include the source code. Additionally, provide a compiled copy that is user installable. Provide all software to the owner on a DVD, CD, Thumb-Drive, or other format acceptable to the Owner.

2.5 CAMPUS COMMUNICATION SYSTEM OR (CCS) SYSTEM DESCRIPTION

A. General

1. The (CCS) Campus Systems described herein and diagrammatically shown in the construction drawings shall set minimum standards, features, and functions to be delivered. The brief descriptions below shall not be interpreted as limiting to functions and / or features required. The Contractor shall specifically identify in their proposal in (RED) letters or yellow highlight any exceptions to features, functions, or devices that would deviate from those specified, depicted, or implied requirements. Or any that would not be delivered by the Contractor’s proposed system or products.

B. The CCS Public Address System

1. Furnish and install a complete Central Public Address voice communications system with all wire, outlets, devices, loudspeakers, and equipment as specified herein, required for fully functional system and or shown on the drawings. The completed installation shall provide a fully operational sound and voice communications system for the Campus.
2. The system shall provide independent communications paths to all classrooms, workrooms, multi-purpose rooms, offices, and exterior speaker locations.
3. Corridor and common area loudspeakers shall be shared in a distributive topology and grouped in logical audio zones. A minimum of ten (10) Hall / Corridor zones shall be provided. Each common area such as Library, Admin Office, Cafetorium, Band Hall, Freshman Center, PAC, etc. shall be grouped in their own independent zone.
4. The audio communications path shall be separate from voice processing system allowing simultaneous use of classroom telephone and receipt of intercom pages to the speaker without interruption.

5. If a telephone system is provided by owner, the system shall be interfaced to the telephone system allowing any telephone location, with the entry of a password, to initiate a page, call a specific room or zone, or initiate an emergency or time tone.
6. The system shall consist of:

    a. Valcom Duo-path Zone Controller
    b. Classroom and Command Area Zones
    c. Power supply with Back-up power
    d. Audio Amplifiers for distribute loudspeaker system
    e. Loudspeaker assemblies
    f. Wiring and all associated material, hardware, necessary for a fully operational system as described herein.

7. The CCS shall provide the following communication paths and functions:

    a. Zoned Paging control to all classrooms within a designated wing and to specially identified zones.
    b. All outside loudspeakers shall be zoned together but cables run independently.

8. The system shall use standard audio path technology for common distribution and IP distribution to each remote zone.
9. The PA shall include UPS battery backup for emergency paging and a minimum of 30+ minutes of up operational time in the event of comical power loss.
10. Local room wiring for speaker and call-in should be cabled with CommScope Cat 6 cable, terminated in a 66 block, plenum, white outer jacket.
11. Common area loudspeaker zones shall have no more than 10 loudspeakers power 1 watt speak per homerun zone and be fed with a Cat 6 twisted pair cable (based on a 400Feet Run). A max of two loudspeakers for power 3 to 5 watt speak per homerun (based on a 400Feet Run)

    a. Contractor will provide appropriate termination blocks for speaker level terminations. Common areas shall have a single zone feed

12. Classroom and Common Zone PA Loudspeakers shall be Valcom V-9022A-2. Each loudspeaker shall be capable of operating at 50mA @ -24VDC, lay-in ceiling grid 2’ x 2’ typical.
13. Additionally, the CCS shall provide the following special features:

    a. Line Level Connectivity to each of the Local Sound Systems. The local sound systems for these spaces are provided by the 274100 scope of work. The 275100 Contractor shall connect to the balanced audio inputs provided on these systems.

2.6 EQUIPMENT GENERAL

A. This document sets forth the minimum CCS equipment requirements. Described are both technical performance specifications along with certain desired features and functions that the Contractor must provide with their proposed system solution.

B. The Construction Drawings shall be referenced for specific devices and interconnections of said devices and together with this written specification form the required minimum (CCS) equipment requirements.

C. The Proposer shall provide one lump sum price for a complete turn-key-system installation per the construction documents. This lump sum price shall be inclusive of all work and material needed for fully functional systems.

D. The Proposer shall provide a lump sum price for each Alternate requested and list them separately from the base proposal lump sum price

E. Collectively the described system forms certain desired features and functions that the Contractor shall provide with their proposed system solution.

1. The Proposer must state clearly in their proposal any exceptions to the equipment and or requirements found in the construction documents to that offered in the Contractors proposal.
2. Additionally, to exceptions, the Proposer shall list clearly any value-added features and or functions their proposed equipment may offer over and above the stated minimums.
3. (CCS) equipment provided and installed shall be as depicted or shown on the construction drawings, described herein this document or more specifically under the System Description above.
4. The Contractor shall be aware that the construction documents in totality identifies the requirements and equipment required to deliver the desired performance, this means the written specifications, drawings, and associated equipment list or generally known in totality as the “Construction Documents.”

F. Proposal Equipment List

1. The Proposer shall provide along with their Proposal Bid Form Provide complete project material/equipment list for each device to be furnished. The Materials List is required to include the following completed categories the following:

a. Quantity of item provided
b. Manufacturer of item
c. Model number of item
d. Description of item

2. The Project Material / Equipment List shall be complete in detail and provided in XL spreadsheet file form and as a PDF document included and attached to the Proposal Form.

G. Contractor shall also furnish any ancillary equipment, devices, cables, connectors, and hardware necessary to provide a complete and functional system.

2.7 PROVIDE AND INSTALL:

A. Campus Communications System

1. The Campus Communication System (CCS) shall provide Public Address for the Administration Office to communicate to a signal room or group of rooms or other common area spaces within the campus. The CCS shall be as described in "The CCS Public Address System" description above. The proposing Contractor shall provide a comprehensive communication system that meets or exceeds the listed requirements. The system shall provide two-way voice communications between Administrative Areas and Classrooms / Instructional spaces throughout the facility.

B. Acceptable Products:

1. Include products by the following manufactures, but not limited to:

    a. Valcom VE6030 - 1 (UPS)

2. Provide uninterruptible power supplies as required to power the server Public Address System for announcements in the event the commercial utility power is lost. The UPS(s) shall be sized accordingly to maintain operational power to the CCS system for emergency announcements for a minimum 30 minutes without commercial power. The UPS must be Wall mountable and be capable of remote manageable by SNMP.
3. Acceptable Products:

    a. Valcom Power Supply VP-6124 with auxiliary battery VP-6124-UPS.

        1) Or approved equal
        2) As required

C. Loudspeakers

1. Provide loudspeakers at the locations indicated on the plans. Note that some loudspeakers are provided by other contractors. To determine which loudspeakers are in the 275100 Contractor's scope, refer to the loudspeaker schedule.
2. Acceptable products:

    a. Refer to loudspeaker schedule in the technology detail sheets.

D. Cable

1. Cable shall be provided and installed that meets manufacturer recommendations for equipment and signal types that are being transmitted. Refer to Division 27 specifications for UTP cable requirements.
2. Paging/ Intercom cable shall be CommScope Cat 6 Twisted cable. Provide plenum rated cable when required.

    a. CommScope Uniprise Cat 6 (white)

E. Cable Termination

1. Speaker to cable terminations shall be terminated with Ideal # 73B wire nuts Common area loudspeaker zones shall have no more than 15 loudspeakers per homerun zone on a 1 watt

speak and a max of two loudspeakers per homerun zone on a 3 to 5 watt speak and be fed with a CommScope Cat 6 Twisted cable.

2. Contractor will provide appropriate termination blocks for speaker level terminations. Common areas shall have a single zone feed

    a. Siemon S89 Bracket and Siemon MC4 Clear Cover and Siemon SA-100 Bridge Clips.

3. CommScope Cat 6 Twisted cable shall terminate Siemon M1-50 connecting block (M-66). At each telecom room provide:

    a. Siemon M1-50 connecting block (M-66)
    b. Siemon S89 Bracket and Siemon MC4 Clear Cover and Siemon SA-100 Bridge Clips.
    c. Approve equal

4. Speaker to cable terminations shall be terminated with the appropriately sized wire nuts.

    a. Typical, Ideal #73B wire nut

PART 3 - EXECUTION

3.1 EXAMINATION

A. The Contractor's responsibilities

1. Examine all related construction documents to ensure compliance of them.
2. Examine and coordinate the installation schedule to comply with contracted timeline.
3. Examine the facility and construction documents to the extent necessary to plan for efficient installation strategies prior to the delivery of materials to the site or the commencement of work.
4. Failure to make the required examinations shall not result in any additional charges to the Owner.

3.2 INSTALLATION

A. Installation Practices

1. All work shall be defect free, and the installer shall replace, at their expense, any work found to be defective.
2. Contractor is responsible for providing a complete and functional intercom and PA systems.
3. All manufactured items, materials, and equipment shall be applied, installed, connected, erected, used, and adjusted as recommended by the manufacturers, or as indicated in their published literature, unless specifically noted herein to the contrary.

4. Contractor shall follow these standards and approved submittals for locations of power supplies. The Owner intends to limit the number and location of power supplies to facilitate more effective long-term support and maintenance of the system.

B. Workmanship

1. All cables and equipment terminating at panels frames shall be vertically straight, with no cables crossing each other, from twelve inches inside the ceiling area to the termination block.
2. All cable bundles shall be combed and bundled to accommodate individual termination block rows and panels.
3. All surface-mounted devices shall be firmly secured level and plumb
4. All rack mount equipment shall be securely installed.

C. Hardware Layout

1. Hardware positioning and layout shall be reviewed and approved by the Consultant and Owner prior to construction. The review does not exempt Contractor from meeting any of the requirements stated in this document.

D. Requirements and Responsibilities

1. The Contractor shall furnish, deliver, transport, erect, install, configure, and connect completely all the materials and equipment described herein, found, or depicted on the construction document package and drawings. The Contractor shall supply all other incidental material required, such as interconnecting cables, connectors, and hardware to make the work complete and leave all systems in first class operating condition.
2. Coordinate with other trades working in the facility to provide seamless installation.
3. In the event of any conflicts, delays or improper preparatory work by other trades or existing conditions, notify the General Contractor, Consultant and Owner.
4. Provide cut-in boxes or approved clamping rings where back boxes are required but not provided by Electrical Contractor.
5. The Contractor shall coordinate their requirements for proper ground system to all equipment.
6. Coordinate and verify with the Electrical Contractor, the installation of needed cable raceways
7. The Contractor shall not use any other trade’s work or material for support or fastening. Example: ceiling grid support wires cannot be used to support cable hangers, etc.
8. The Contractor shall not shoot, fasten, or screw hangers to the roof deck.
9. Coordinate clearance for cable paths and coordinate clearance for access above cable tray to easily add or remove cable from the cable tray they install.
10. Provide all interconnecting cables to and/or between same equipment required to make equipment fully operational.
11. Equipment shall be fabricated for wall mounting, enclosures, and consoles and be fully wired and tested, before delivery to job site.
12. With the installation of equipment and cables, consideration shall be given not only to operation efficiency but also to overall aesthetic factors to comply with industry standards and practices.
13. Contractor’s construction, fabrication, installation, or delivery of materials must comply with applicable standards and practices.

14. Coordinate and field-verify the electrical rough-ins provided for their use by the Electrical Contractor.
15. Remove and replace cabling that is found to have been stretched or pulled past the recommended pulling tension during installation.
16. Install all operational software, as required by equipment, and ensure that such software is fully functional and operational. In the event of software conflicts due to upgrades, bugs, or other reasons, the Contractor shall provide solutions suitable to Owner at no additional cost.
17. The Contractor shall be responsible for coordination with Owner's staff the software configuration options of software configurable systems.
18. Provide to the Owner keys for all lockable equipment installed.
19. Provide all passwords for any system or equipment that may use or be locked with a password.
20. The Contractor shall provide and program the system ready for the owner's use.
21. Provide a CAT6a cable (reference cabling standards) run for each server and gateways or any other device that will required network connectivity.

E. Procedures & Methods

1. Equipment shall be wall-mounted, and fully wired and tested, before delivery to job site.
2. Equipment and enclosures shall be mounted plumb and square in relation to the structure.
3. Devices, wire raceways, and equipment, except for portable equipment, shall be permanently attached to equipment racks or building structure and held firmly in place with screws or fasteners. Adhesives alone shall not be accepted as fasteners.
4. All equipment mounting boards in head-end rooms, MER's, electrical, or TR closets shall be painted white or black as location dictates with fire retardant paint. The mounting boards shall be made of high-grade plywood.
5. Cable Termination

    a. Termination hardware (blocks and patch panels) positioning and layout shall be reviewed and approved by the Owner prior to construction. The review does not exempt Contractor from meeting any of the requirements stated in this document.

F. Device Cabling/Wiring Installation Practices

1. Cable installation must follow related TIA/EIA standards and recommendations, including methodology as noted in TIA/EIA 569 - Part 4.6 Ceiling Pathways. Specifically, including sections 4.6.1 General, 4.6.2 Design Guidelines, and 4.6.5 Cable Support.
2. All equipment wiring, and cabling shall be neatly laced, ends dressed in heat shrink tubing, and all cables shall have service loops between the horizontal tie bar and the connection to equipment. Wall cabling shall be adequately supported with tie wraps or Velcro wire wraps and horizontal support bars to rack frame as it enters or exits the front or back of equipment.
3. There shall be no unmarked cables at any place in any part of any system, this includes both ends of the cables and patches.
4. Label markings codes used on cables shall correspond and be shown clearly on as built drawings
5. All cables shall be separated into like groups according to signal or power levels and routed separately to eliminate signal contamination and cross-talk.
6. All power cables, control cables, and high-level cables shall be grouped to one side of the equipment while low level cables shall be grouped to the other side.

7. All cables will use Velcro wire wraps to manage and bundle cables. Velcro strips will be no more than a ¼" wide.
8. All cabling located above ceilings shall be tied off to and supported by ceiling supports or other structures at a minimum of eighteen inches above the ceiling.
9. Cabling shall be placed in conduit where exposed in gym roof joist. Exposed cables shall not be allowed.
10. All external wire and cables shall be supported at least every five feet from the structure or as required to maintain not more than 12" cable sag between supports and without over tensioning the cables. Provide j-hooks as needed where cable tray or raceway is not available.
11. Coordinate installation with Division 270500 cabling to ensure there is at least 2-inches of physical separation between security cabling and voice/data cabling throughout cable path. Voice/data cabling shall have first priority for placement in cable tray.
12. PA speaker cabling shall not share cable pathways with other cabling.
13. All cables, regardless of length, shall be labeled within 18" of both ends with an identifier that is keyed to the door, room, or corridor number as identified.
14. All cables shall have 6-foot service loops neatly coiled in the equipment room. During initial cable rough-in, this Contractor shall have sufficient slack to route anywhere within the equipment room.
15. Cabling shall be adequately supported with Velcro wire wraps and horizontal support cable managers fastened to rack frame. Cables shall be dressed in a neat and orderly fashion. Any cabling or equipment installation that is deemed unacceptable by the Owner or Consultant shall be replaced or corrected by the Contractor at no additional cost. Plastic zip ties are not allowed.
16. All cables are to run at right angles to the structure, placed above the ceiling in halls or corridors.
17. Cables shall not run above red iron joist.
18. Contractor shall make every effort to conceal wiring and other apparatus into walls, floors, and ceilings, assuming code and good engineering practice allows and suggests.
19. Contractor shall notify Owner immediately if obstruction or hazard is discovered in a pathway.
20. Cable shall be stored and handled to assure that it is not stretched, kinked, crushed, or abraded in any way. Bend radiuses shall meet manufacturer specifications and/or recommendations. Cable shall not be installed in ambient temperatures or moisture conditions above or below the manufacturer’s rating.
21. No splices shall be installed in any UTP cable unless prior approval from Consultant is given.

G. Equipment and Cable Labels:

1. All cables, regardless of length, shall be marked with indelible color-coded labels that have unique identifying number that corresponds with those found on the schematic diagrams and Record drawings.
2. Labels shall be directly hot stamped or factory-stamped with closed sleeve method. Adhesive strip labels may only be used if protected by transparent heat-shrink tubing.
3. Marking codes used on cables shall correspond and be shown clearly on Record drawings.
4. Cat 6 cable for PA must have his own pathways and cannot use the cable tray or any of the technology pathways.
5. Provide all proposed wording and / or numbering scheme for labeling to the Consultant for review and written approval prior to procurement or installation.

6. All wall plates shall be labeled with Input and Output identifications and referenced to corresponding operational software or hardware it serves.
7. All labels used must be permanent and secure. Provide labeling as follows unless otherwise noted in a specific section:

    a. Provide engraved Lamacoid labels at the front of all equipment. Labels shall indicate equipment type and model number and correspond to the Record drawings for equipment identification.
    b. Labels shall be uniform in size. All adjacent labels shall be sized to match the other labels used for same purpose. Similarly, provide engraved labels of like size in other locations.
    c. All label lettering shall be a minimum of .08" high.
    d. Embossed adhesive labels are not acceptable.
    e. Unless otherwise noted, labels on dark panels shall be black with white letters. Labels on stainless steel or brushed natural aluminum plates or light-colored panels shall be white with black lettering.
    f. All wall plates shall have input and output connectors labeled in a professional and permanent manner, no hand-written labels shall be accepted.
    g. Cable and Jack labels shall include room identification with unique cable number, jack location within the room, and MDF or IDF number.
    h. The Contractor shall use actual room identifications in their labeling scheme. Contractor shall obtain written approval from the Owner for the actual room numbers, and labeling scheme, to be used prior to installation.
    i. Switches, connectors, jacks, receptacles, outlets, cables, and cable terminations shall be logically and permanently marked in a manner approved by the Consultant.
    j. Custom panel nomenclature shall be engraved, etched, or screened. Markings for these items are purposely detailed in the construction drawings to ensure consistency and clarity. Verify markings and placement with the Consultant prior to procurement. Submit label sample layouts for Project Consultant’s review.
    k. All terminal blocks, wall mounted equipment, and active slots of card frame systems shall be clearly and logically labeled in a manner acceptable to the Consultant.
    l. All labeling information shall appear on the Record drawings as device and equipment cross-reference identifier and servicing aids.

H. Connections and Connectors

1. Connections shall be made with approved connectors on cables, terminal blocks, or punch blocks. Crimp style connectors shall be made with proper crimping tool. Two-point crimps will not be accepted.
2. RF cable connectors shall be made with hex crimp.
3. Cables shall be terminated with the proper connector specifically produced for use with each type of cable.
4. Video connectors that are not of solder type (HDMI, BNC, RCA, F, etc.) shall be terminated using a crimp tool or dies designed specifically for the connectors being applied.
5. XLR type connectors shall be wired with pin 2 high, pin 3 low, and pin 1 shield.
6. Mechanical connectors must be specially made for type of cable or wire used.
7. Connector adapters will not be allowed in any part of the system.
8. Twist on connectors shall not be allowed.
9. Solder joints will be made with rosin-core solder.

I. Interconnection

1. Contractor shall make all system interconnections as necessary, as indicated on the Drawings, or specified herein.
2. Contractor shall provide power and control cables to and from power supplies, remotely controlled equipment and other devices even though such cables are not explicitly indicated on Drawings or listed in equipment tables.

J. Cable Management

1. Cabling located above ceilings shall be tied off to and supported with cable hangers fastened directly to the structure.

K. Equipment Mounting

1. Install Valcom systems for wall mounting only.

3.3 CONSTRUCTION

A. Required typical system mockups

1. The Contractor shall build typical mockups as required and complete in detail for review by the Owner and Consultant prior to their final equipment install in the rest of the facility. Once reviewed and accepted, this mockup shall be the approved configuration model to install in the remaining locations. Mockups for this project include but are not limited to the following:

B. Special Techniques

1. Installers of infrared devices shall be aware of other infrared devices and infrared interference in the facility and take whatever precautions necessary to avoid this causing problem to other equipment operations. For example, cover all IR receiver sensors.
2. Installers of any RF devices shall be aware that RF devices may cause interference to the equipment and take whatever precautions necessary to avoid causing interference.

3.4 PROTECTION AND CLEANING

A. Equipment

1. The Contractor shall coordinate with other trades to provide an acceptable environment for installed equipment. For example, provide a dust free environment for VCRs, laser disk players, CD players, etc.
2. Cover installed equipment racks for protection during high dust periods.
3. Do not operate equipment with fans during high dust periods of the installation.
4. Coil and protect cabling from damage prior to termination to equipment

B. Prior to system turnover to Owner:

1. Remove all dirt and debris from equipment racks and equipment rooms.
2. Clean all equipment filters, vents, and fans.
3. Clean all enclosures and back box interiors thoroughly before installing plates, panels, or covers.

3.5 CLOSE OUT & QUALITY CONTROL

A. The following shall be complete and in place before final system inspection & demonstration is scheduled and performed with the Owner's Consultant:

1. Provide written detailed completion reports of system testing
2. Dust, debris, solder splatter, etc. is removed
3. Cables are dressed, routed, and labeled with heat-shrink tubing over label at ends
4. Connections are confirmed consistent regarding polarity
5. Equipment operation tested and operating normally
6. Equipment software is installed and configured
7. Electronic devices are properly grounded
8. Devices requiring AC Power are Powered and from the proper circuit
9. Test each AC power receptacle for proper hot, neutral, and ground connections
10. Interconnecting patch cables and jumpers are in place
11. The system documentation is complete with Record Drawings available
12. All contractual system specifications are fully met, in detail and intent.

B. TESTING & ADJUSTING

1. Refer to Section 270000 for additional requirements.
2. The Contractor will be responsible for adjusting the installed system and notifying the Consultant when system adjustments have been completed:

    a. In accordance with Construction Documents
    b. As required, to provide the Owner a fully functional system at system turnover
    c. As directed by the Consultant

3. Prior to energizing or testing the system, ensure the following:

    a. All products are installed in a proper and safe manner per the manufacturer's instructions.
    b. Dust, debris, solder, splatter, etc., is removed.
    c. Cable is dressed, routed, and labeled; connections are consistent regarding polarity.
    d. All products are neat, clean, and unmarred, and parts are securely attached.

4. Contractor shall ensure that each device in the system is functioning normally and in such a manner as to meet the functional and performance requirements in this specification.
5. Contractor shall be responsible for the following testing procedures:

    a. Measure each area's ambient noise level during normal business operation.
    b. Provide amplifier(s) and estimate speaker transformer tap values that provide acceptable performance without exceeding 80% of the amplifier's RMS power.

c. Acceptable performance is deemed to mean that a voice page or intercom call is 15 dB over the Ambient Noise level when measured at 5 feet above finished floor. Make all necessary adjustments per Owner and Consultant request.

6. Contractor shall ensure the overhead paging system voice pages are a minimum of 15 dB over the Ambient Noise Level in each area without exceeding 80% of the amplifiers' rated power.
7. Inspection: After Contractor's testing is complete and the system is properly adjusted, the Contractor shall contact the Owner to schedule a "spot test" of the system with the Owner and Consultant. Contractor shall make changes/adjustments per Owner and Consultant's request at no additional cost to Owner. These adjustments may include but not be limited to:

   a. Adjusting volume control of amplifier.
   b. Adjusting local volume control of individual speaker.
   c. Re-tapping up to 20% of speakers at different wattage.

8. Notification: When above tests have been completed and system is ready for inspection, notify Consultant in writing at least seven working days prior to inspection. Include in this notice copies of all data recorded, date each test was completed and results of each test. All test data shall be available during inspection process.
9. Inspection: After Contractor's testing is complete and the system is properly adjusted, the Contractor shall contact the Owner to schedule a "spot test" of the system with the Owner and Consultant. Contractor shall make changes/adjustments per Owner and Consultant's request at no additional cost to Owner. These adjustments may include but not be limited to:

   a. Adjusting volume control of amplifier.
   b. Adjusting local volume control of individual speaker.
   c. Re-tapping up to 20% of speakers at different wattage.

3.6 WARRANTY

A. Refer to Section 270000 for additional requirements.

3.7 DEMONSTRATION

A. The final acceptance, with proof of performance and operational verifications for the installed Audio & Video Systems shall be the responsibility of and performed by the Contractor in the presence of the Consultant and Owner's representative.

B. Final acceptance shall be in accordance with Construction Documents, General Conditions, and Division 27 Technology General Requirements.

C. The Contractor shall notify the Consultant 10 days' prior substantial completion and intended schedule for the final acceptance walkthrough demonstration.

D. Acceptance Testing shall include, but not be limited to the following:

1. Demonstration of all system operations to the Consultant as the Owner's representative.
2. A minimum of two (2) installation technicians provided by the Contractor to assist the project Consultant, as required, during final test verification and final acceptance demonstration.
3. The technicians shall be equipped to perform necessary corrections to the system. They Contractor shall provide test equipment capable of testing any and all parts of the equipment, cabling, or systems.
4. The minimum required test equipment shall include but not be limited to the following:

    a. Three (3) two-way radios, that covers the area of testing, for communications between Contractor and Consultant
    b. Multimeter for reading AC / DC Voltage, Amperage, Resistance, and continuity
    c. Sound level meter calibrated in dB with A, C, and flat filters
    d. Audio Tone Generator and audio signal tracer
    e. Calibrated Pink Noise Generator
    f. Real Time Audio Analyzer (RTA)
    g. Audio acoustical pulse polarity / phase tester
    h. Computer with installed device software and connecting cables, example DSP

5. The Contractor shall be responsible for equipment adjustments to ensure normal and proper operation. Owner required system adjustments will be made by the Contractor as directed by Owner or Project Consultant during final testing
6. During the final acceptance walkthrough, the Contractor shall demonstrate operation of each major component and functional requirement as specified herein.
7. If any portion of the system does not appear to be functioning properly during the final acceptance walkthrough the Contractor shall do further test, along with corrective actions that may be immediately possible. If the need for further corrections or corrective actions does not resolve the issue the demonstration, at the Consultant's discursion, shall be discontinued until the system operates properly.
8. The Contractor shall remain responsible for all equipment, labor, hardware, and documentation, in part and in total, until Owner accepts such work or material in writing.

3.8 OWNER'S TRAINING

A. Refer to Section 270000 for additional requirements.

B. Provide system operations, administration, and maintenance training by factory-trained personnel qualified to instruct.

C. Training Requirements

1. Owner Training of the completed installation is an important part of the overall success of this project and therefor the installing Contractor shall provide comprehensive system training to the Owner as defined below and with the minimum training hours as specified.
2. Prior to scheduling or delivering Owner Training confirm the following:
3. System Record documentation must be provided for review to Owner and Consultant.

    a. System final walkthrough inspection must be completed.

b. Training materials and program outline must be provided and approved by the Owner / Consultant.
c. Training schedule must be coordinated with the Owner and Consultant.

D. Training is to include:

1. Detailed training plan that meets approval by the Consultant and the Owner
2. Practical and comprehensive operation of system
3. Basic system troubleshooting techniques
4. Digital Video file of each training session. Furnish two edited copies to the Owner

E. Training Hours

1. The Owner reserves the right to establish training times, duration, and training topics within the total training time allotted. Training Session Blocks, as defined below, can at the Owner's request be combined in any combination
2. Provide each group of users, as defined below, with the minimum training hours as specified.
3. Training time shall be defined as those hours specifically set-aside for the sole purpose of training District personnel. Credited time shall not be given for time spent providing instructions to the Owner's staff for a system not completed or that has not passed final acceptance by the Owner and Consultant, or training performed outside of the approved training plan.
4. The Contractor shall issue a certificate of training completion to the trainees, upon completion of their training. Both the trainer and trainee(s) must sign the certificate before Contractor shall receive final payment.
5. The Contractor shall provide a minimum of (8) eight hours of Owner training. This training shall be divided into training session "Blocks" as coordinated with the Owner.
6. The first block session will consist of a two-hour training period and occur when the basic system comes online. This training shall primarily be intended for the common system operators.
7. The second block will consist of a two-hour training period and will occur as directed by the Owner. This training session shall be structured for high-level users, for example staff champions that will provide instruction to other users.
8. The third block will consist of a two-hour training period to assist the staff champions with training the end users. This training shall consist of a training session structured for Advanced System Configuration and Operational Knowledge needed to maintain and manage all systems. It shall include basic troubleshooting skills.
9. The fourth training session shall be structured as requested by the Owner. Unless otherwise directed, provide a minimum of four (2) two hours of special in-service training for District's maintenance personnel. This training shall cover system overview and any special maintenance requirements. The owner will designate the personnel to attend this training and the systems to be covered.

F. Training sessions shall cover at a minimum:

1. Basic System Configuration and Operation Knowledge
2. Advance System Configuration and Operation Knowledge
3. Typical system usage
4. Typical User troubleshooting skills

5. Service and maintenance requirements
6. The Owner reserves the right to establish training times, duration, and topics.

3.9 FIRE STOPPING

A. Fire stopping of openings between floors, fire-rated walls, and smoke-rated walls, created by others for This Contractor to pass cable through, shall be the responsibility of the This Contractor. Sealing material and application of this material shall be accomplished in such a manner that is acceptable to the local fire and building authorities having jurisdiction over this work.

B. Any openings created by or for this Contractor and left unused shall be sealed up by this Contractor.

C. This Contractor shall be responsible for creating a waterproof seal in and around any openings that This Contractor creates from the structure to the outside environment.

D. Any existing openings discovered that should be fire stopped should be brought to the attention of the Owner.

3.10 DOCUMENTATION

A. Upon completion of the installation, Contractor shall provide full documentation sets to the Consultant for approval as described in section 270000 and 276000. All documentation shall become the property of the Owner.

B. Documentation shall include the additional specific items detailed in the subsections below:

1. Contractor shall provide hard copy and electronic forms of the final test results.
2. Contractor shall provide a document including the following:

    a. Device label/identifier
    b. Location of each drop by orientation/permanent landmark in the room
    c. Contractor shall provide accurate Record Construction Drawings. The drawings are to include cable routes and device locations.

3.11 FINAL ACCEPTANCE

A. In addition to closeout requirements in section 270000 and 276000, This Contractor shall demonstrate the following before final approval.

1. Owner training is complete.
2. Punch list items are complete.
3. Record documentation is complete and submitted to Owner/Consultant.

3.12 ANNUAL SUPPORT AGREEMENT

A. An annual support agreement (after the 1st year full of support/warranty) shall not be part of the bid. The Contractor shall work directly with the Owner at the end of the project to determine the ongoing hardware/software support. The Contractor shall send the Consultant a copy of the support agreement for review prior to finalization.

3.13 FINAL PROCEDURES

A. Perform final procedures in accordance with Sections 270000 and 276000.

END OF SECTION 27510

SECTION 276000 - PHYSICAL SECURITY GENERAL REQUIREMENTS

PART 1 - GENERAL

1.1 SCOPE

A. Refer to Section 270000 for additional project scope information. This section describes the general product and execution requirements related to furnishing and installing Physical Security Systems. Physical Security Systems include Video Surveillance, Electronic Access Control, Intrusion Detection, and their sub-systems.

B. This is a 24/7/365 mission-critical facility, and all systems shall be capable of a 99.99% uptime by utilizing redundant power supplies, enterprise-grade components, UPS power, and failover.

C. Contractor shall be responsible for providing complete and functional systems as described in this specification and project drawings.

D. Contractor shall provide low voltage power and control lines to and from power supplies, remotely controlled equipment, and other devices, even though not explicitly indicated on drawings or listed in equipment tables.

E. Contractor shall be, or Contractor shall provide, an Electrical Contractor for provision of high voltage power and conduits/raceway, where necessary.

F. Contractor shall be responsible for any and all related programming and end-user training unless noted otherwise.

G. These systems will integrate like a single pane of glass. Open Options, VMS (Hanwha), and Bosch.

H. Existing systems/devices being demolished to be returned to owner for first right of refusal.

1.2 RELATED WORK

A. Section 270000 – General Technology Requirements

B. Section 270500 – Communications General Requirements

C. Section 270526 – Grounding and Bonding for Technology Systems

D. Section 270528 – Pathways for Technology Systems

E. Section 270537 – Firestopping for Technology Systems

F. Section 271100 – Communications Equipment Rooms

G. Section 271500 – Communications Horizontal Cabling

H. Section 271600 – Communications Connecting Cords

I. Section 271800 – Communications Labeling and Identification

J. Section 275100 – Distributed Communications Systems

K. Section 276200 – Electronic Access Control System

L. Section 276400 – Video Surveillance System

M. Section 276600 – Intrusion Detection System

N. Section 276800 – Detention Security Systems

1.3 DEFINITIONS

A. Refer to Section 270000 for additional definitions.

1.4 REFERENCE STANDARDS AND CODES

A. Refer to Section 270000 for additional requirements.

1.5 QUALIFICATIONS

A. Refer to Section 270000 for additional requirements. Training: Programmer shall have received manufacturer-provided and/or manufacturer-approved training in the configuration of the physical security system(s) being provided.

B. Certification: Programmer shall hold the highest applicable manufacturer programming certification(s) offered by the manufacturer(s) of the physical security system(s).

C. Submittal: Certification certificate shall be submitted with physical security system(s) submittals.

1.6 PRE-CONSTRUCTION SUBMITTALS

A. Refer to Section 270000 for additional requirements. Hardware, Application Software, and Network Requirements: A system description including analysis and calculations used in sizing equipment required by the Physical Security Systems. The description shall show how the equipment will operate as a system to meet the performance requirements of the systems. The following information shall be supplied as a minimum:

1. Server(s) processor(s), disk space and memory size
2. Workstation(s) processor(s), disk space and memory size
3. Operating System(s) Software, where software is provided or upgraded
4. Application Software, with Optional and Custom Software Modules, supplied in this project

5. Integration Schemes: Proposed connectivity, software, development requirements, and SDK information for inter-system communication.
6. Network reliability requirements
7. Number and location of LAN ports required
8. Number of IP addresses required.
9. Other specific network requirements, preferences, and constraints
10. Backup/archive system size and configuration
11. Start-up operations
12. Description of site (field) control equipment (Controllers/Field Panels) and their configuration
13. Access control power calculations.
14. Battery backup requirements

1.7 CONSTRUCTION PROGRESS SUBMITTALS

A. Refer to Section 270000 for additional requirements.

1.8 CLOSEOUT SUBMITTALS

A. Refer to Section 270000 for additional requirements.

B. Quick-Reference Guides: Contractor shall create a concise quick-reference guide covering normal system operation and basic troubleshooting procedures for each room/system type. Length of each quick-reference guide shall be commensurate with the information needed for successful operation, subject to Owner approval.

1. Upon Owner approval, Contractor shall provide two (2) laminated copies and one (1) digital copy for each room/system type.

C. Serial Numbers: Contractor shall provide a list of serial numbers for all supplied components with serial numbers and with a unit price greater than $99. Organize the list by room/system type.

PART 2 - PRODUCTS

2.1 SUBSTITUTIONS

A. Unless noted otherwise, products in this section are intended as a basis of design and are open to substitutions per the product substitution procedures defined in Section 270000.

2.2 GROUNDING AND BONDING

A. Contractor shall bond and ground the primary protectors and the metallic member of cable sheaths to building ground utilizing a minimum of 14-awg and no greater than 6-awg at the closest point of entrance as practical, not exceeding 50 feet, in accordance with the NEC.

2.3 REFER TO INDIVIDUAL SECTIONS FOR ADDITIONAL PRODUCT INFORMATION.

2.4 FIRE STOPPING MATERIALS

A. Refer to Section 270000 for additional requirements.

PART 3 - EXECUTION

3.1 NETWORK TIME PROTOCOL (NTP) SYNCHRONIZATION

A. All security systems, as well as additional integrated systems such as intercom/PA, SQL/database servers, and data logging servers, shall synchronize to a common NTP server.

B. All systems, including servers and workstations, shall be within 250ms of each other or less, depending on specific system requirements such as failover. The synchronization frequency shall be no less than every 1 hour. Contractor shall use software such as NetTime (www.timesynctool.com) installed on the servers.

C. Contractor shall coordinate with the Owner for an NTP server connection address.

D. Workstations on the private security network shall have an NTP client, such as NetTime operating as a Windows service to sync the workstation's clock to the same NTP server as the rest of the security systems.

3.2 TESTING

A. Refer to Section 270000 for additional requirements.

3.3 TRAINING

A. Refer to Section 270000 for additional requirements.

B. On-Site Training

1. General: Present, review and describe equipment and materials to the Owner and Owner's operating personnel and fully demonstrate the operation and maintenance of the systems, equipment, and devices specified herein.
2. Include with new systems, the Contractor to arrange and provide for video recording of each onsite training session.

    a. Provide professional video and audio recordings of each software screen option with Owner approval of content.
    b. Provide end-user video recording for all training levels.

3. Training shall comprise two separate levels of training.

a. User Group upon substantial completion of the project.

1) User group training shall include a site/building walk-through indicating locations of equipment and their usage.
2) User group training shall include the operation of workstation capability of system monitoring, command override, and report generation.

b. Maintenance Group upon completion of the project prior to close out.

1) Maintenance group training shall include a site/building walk-through indicating locations of equipment and their usage at up to six representative sites.
2) Review of a-build documentation at each controller location.
3) Troubleshooting techniques in hardware and software.

4. The training shall cover the overall system, each individual system, each subsystem, and each component. The training shall also cover procedures for database management, normal operations, and failure modes, with response procedures for each failure. Each procedural item shall be applied to each equipment level.

C. Duration: Refer to the individual sections for the minimum time requirements.

3.4 WARRANTY

A. Refer to Section 270000 for additional requirements.

B. Furnish and guarantee maintenance, repair, and inspection service for the system using factory-trained authorized representatives of the manufacturer of the equipment for a period of one year after the final acceptance of the installation.

C. Third-Party Device warranties are transferred from the manufacturer to Contractor, which may then transfer third-party warranties to the Owner. Specific third-party warranty details, terms and conditions, remedies, and procedures, are either expressly stated on, packaged with, or accompanying such products. The warranty period may vary from product to product. These products include but are not limited to devices that are directly interconnected to the field hardware or computers and are purchased directly from the manufacturer.

D. Purpose

1. Contractor shall repair any system malfunction or installation deficiency discovered by the Owner or their representatives during the burn-in and warranty period.
2. Contractor shall correct any installation deficiencies found against the contract drawings and specifications discovered by the Owner or their representatives during the warranty period.

3.5 EXAMINATION OF SITE AND DOCUMENTS

A. Bidder shall examine all documents, shall visit the site(s) prior to submitting a proposal, record their own investigations, and shall inform themselves of all conditions under which the Work is to be performed at the site(s) of the Work, including the structure of the ground, the obstacles that may be encountered, and all of the conditions of the documents, including superintendence of the Work, requirements of temporary environmental controls, the time of completion, list of Subcontractors, and all other relevant matters that may affect the Work or the proposal process.

B. Verify cable lengths comply with published standards.

C. Notify the Owner/Consultant of installation that would exceed maximum lengths prior to installation of the cable.

D. Contactor shall consult with the Owner/Consultant regarding alternative routing or location of the cable.

E. Do not proceed until unsatisfactory conditions have been corrected.

F. Failure to make the examination shall not result in any Change Order requests.

G. The Bidder shall base the proposal on the site(s) examination and materials complying with the plans and specifications and shall list all materials where the proposal form requires.

H. The commencement of work by Contractor shall indicate acceptance of existing conditions unless a written notice of exceptions has been provided to the Owner/Consultant prior to commencement.

I. If Contractor observes, during preliminary examinations or subsequent work, existing violations of fire stopping, electrical wiring, grounding, or other safety- or code-related issues, Contractor shall report these to the Owner/Consultant in a timely manner.

3.6 SPARE PARTS

A. Licenses: 5 camera licenses,1 Bosch integration to OpenOptions, one VMS integration to OpenOptions.

B. Cameras: One of each model.

C. Card Readers: One of each different electrified hardware.

3.7 INSTALLATION REQUIREMENTS

A. Refer to Section 270000 for additional requirements.

B. Contractor shall furnish and install all cables, connectors, and equipment as shown on the Drawings and as specified herein.

C. It is Contractor's responsibility to survey the site and include all necessary costs to perform the installation as specified. This includes any modifications required to route and conceal horizontal distribution wiring.

D. Beginning installation means Contractor accepts existing conditions.

E. Contractor shall be responsible for identifying and reporting to the General Contractor any existing damage to walls, flooring, tiles, and furnishings in the work area prior to the start of work. All damage to interior spaces caused by the installation of cable, raceway, or other hardware shall be repaired by Contractor.

F. Repairs shall match the preexisting color and finish of walls, floors, and ceilings. Any Contractor-damaged ceiling tiles, floor, and carpet shall be replaced to match color, size, style, and texture.

G. Where unacceptable conditions are found, Contractor shall bring this to the attention of the construction supervisor immediately. A written resolution will follow to determine the appropriate action to be taken.

H. All wiring shall be run "free-air," in conduit, in a secured plastic raceway, or in modular furniture as designated on the Drawings. All cables shall be free of tension at both ends. PLENUM-rated cable shall be used in areas used for air handling.

I. Avoid abrasion and other damage to cables during installation.

J. The cable system will be tested and documented upon completion of the installation, as defined in the section below.

K. All manufactured items, materials, and equipment shall be applied, installed, connected, erected, used, and adjusted as recommended by manufacturers or as indicated in their published literature unless specifically noted herein to the contrary.

3.8 COOPERATION

A. Contractor shall cooperate with the Consultant's and Owner's personnel in locating work in a proper manner.

B. Should it be necessary to raise, lower, or move longitudinally any part of the work to better fit the general installation, such work shall be done at no extra cost to the Owner, provided, such decision is reached prior to the actual installation. Contractor shall check the location of electrical outlets with respect to other installations before installing.

3.9 COMMISSIONING SUBMITTALS

A. Provide the following to the Owner no later than 30 days prior to system commissioning/programming.

1. Commissioning Test Plan and Check-Off List: Specified elsewhere in this document.

2. Software: One set of fully functional software in the manufacturer's original media packaging, temporarily licensed for a 30-day evaluation period.
3. Web-based Training: Access to web-based training modules.

3.10 COMMISSIONING

A. Provide programming and commissioning for each system as described in individual sections below.

B. Contractor shall develop and submit a plan for coordination of settings and programming issues with the Consultant and Owner no later than 30 days prior to performing programming and commissioning.

C. The security Contractor is required to place the entire system into full and proper operation as designed and specified.

D. Verify that all hardware components are properly installed, connected, communicating, and operating correctly.

E. Verify that all system software is installed, configured, and complies with specified functional requirements.

F. Perform final acceptance testing in the presence of the Owner's representative, executing a point-by-point inspection against a documented test plan that demonstrates compliance with system requirements as designed and specified.

1. Submit documented test plan to the Owner at least 14 days in advance of acceptance test, inspection, and check-off.
2. Conduct final acceptance tests in the presence of the Owner's representative, verifying that each device point and sequence is operating correctly and properly reporting back to the control panel and control center.
3. Acceptance by the Owner is contingent on successful completion of check-off; if check-off is not completed due to additional work required, re-schedule and perform complete check-off until complete in one pass unless portions of the system can be verified as not adversely affected by additional work.
4. The system shall not be considered accepted until all acceptance test items have been successfully checked off. Beneficial use of part or all of the system shall not be considered as acceptance.

3.11 OPERATION AND MAINTENANCE MANUALS

A. Part One: Notwithstanding requirements specified elsewhere, submit the following labeled as the "Operating and Maintenance Manual" within thirty (30) days after the Final Acceptance of the Installation:

1. Record Drawings: Submit two (2) copies of revised versions of drawings as submitted in the "Shop and Field" and "Equipment Wiring Diagrams" Submittals showing actual device locations, conduit routing, wiring, and relationships as they were constructed. Include

nomenclature showing as-built wire designations and colors. Drawings shall include room numbers coinciding with Owner space planning numbering. Drawings shall be submitted in electronic editable AutoCAD 2010 files, in ".dwg" format, on CD or DVD disks.

2. Manuals: Submit two (2) copies of each of the following materials inbound manuals or electronic PDF copies with labeled dividers:

    a. A final Bill of Material for each system
    b. Equipment Instruction Manuals: Complete, project-specific comprehensive instructions for the operation of devices and equipment provided as part of this work.
    c. Manufacturers Instruction Manuals: Specification sheets, brochures, Operation Manuals, and service sheets published by the manufacturers of the components, devices, and equipment provided.
    d. Include information for testing, repair, troubleshooting, assembly, disassembly, and recommended maintenance intervals.
    e. Provide a replacement parts list with current prices. Include a list of recommended spare parts, tools, and instruments for testing and maintenance purposes.
    f. Performance, Test, and Adjustment Data: Comprehensive documentation of performance verification according to parameters specified herein.
    g. Warranties: Provide an executed copy of the Warranty Agreement and copies of all manufacturer's Warranty Registration papers as described herein.

B. Part Two: Within fourteen (14) days of receipt of the Consultant reviewed Operating and Maintenance Manual (Phase One), submit three (3) electronic copies in AutoCAD 2010 editable .dwg format of the reviewed Record Drawings and three (3) copies of the reviewed Operating and Maintenance Manuals to the Owner, on CD or DVD disks.

1. Within each equipment enclosure and/or terminal cabinet, Contractor shall place a Single Line drawing of the system(s) and the respective Terminal Cabinet Wiring Diagram in a clear plastic sleeve permanently attached to the inside cover of the terminal cabinet.
2. In each equipment enclosure, Contractor shall place a drawing providing device locations served by the equipment within the enclosure with identification that is identical to the wiring tags and with the software description of each point.
3. Contractor shall provide to the Owner one (1) copy of new administration and user software, including required graphical maps, on CD or DVD disks.

C. Sufficient information (detailed schematics of subsystems, assemblies, and subassemblies to component level) clearly presented shall be included to determine compliance with drawings and specifications.

3.12 CLOSEOUT PROCEDURES

A. Notification: Contractor shall provide written notification to the Architect/Consultant and Owner when Contractor is satisfied that the work has been completed and is ready for inspection.

B. Closeout Submittals: Contractor shall provide closeout documentation to the Architect/Consultant. The Architect/Consultant shall receive the closeout submittals no less than 72 hours prior to the scheduled inspection time.

C. Inspection: Contractor shall be present for the inspection by the Architect/Consultant. Contractor shall supply all testing equipment needed to verify compliance with the specifications found in the Bid package.

D. Punch List: Work or materials found to be incomplete, of unsatisfactory quality, failing to meet the specifications in the Bid package, and/or unacceptable to the Architect/Consultant shall be documented by the Architect/Consultant and provided to Contractor to rectify.

E. Re-Inspection: If a re-inspection is necessary, the costs of the Architect/Consultant's additional travel, hours, and expenses may be deducted by the Owner from the contract amount due to Contractor.

F. Punch List Approval: The punch list shall be considered complete only after having been signed by the Owner and Architect/Consultant.

G. The system has successfully completed a 30-day performance period.

H. Payment Authorization: Final payment will be authorized only after all closeout procedures and requirements have been followed and fulfilled by Contractor and approved in writing by the Owner and Architect/Consultant, including punch list(s) and/or re-inspection(s).

END OF SECTION 276000

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SECTION 276200 - ELECTRONIC ACCESS CONTROL SYSTEM

PART 1 - GENERAL

1.1 SCOPE

A. ACS (OpenOptions) will integrate with VMS and Bosch Intrusion. Contractor to program alarms, virtual zone, lockdowns, mapping, and camera automation in the alarm setting. The system will be fully integrated and functional as one single pane of glass.

B. This specification section covers the furnishing and installation of new components for adding electronically-controlled portals into an existing enterprise-wide, low-voltage Electronic Access Control System (EACS).

C. Contractor shall furnish and install access control hardware devices, mounting brackets, power supplies, switches, controls, consoles, and other components of the system as shown and specified.

D. Contractor shall furnish and install access control-related software to allow for system expansion. Software includes required license addition(s) for access control readers and electrified portals, workstations, and required physical security system Integration.

E. Furnish and install outlets, junction boxes, conduits, connectors, wiring, and other accessories necessary to complete the system installation. Requirements shall be in accordance with Division 26 00 00, Electrical.

F. Refer to Section 270000 for additional project scope information.

G. Contractor to provide integration licenses for OpenOptions to integrate with Bosch and VMS.

H. Existing systems/devices being demolished to be returned to owner for first right of refusal.

1.2 PRECEDENCE

A. Obtain, read, and comply with General Conditions and applicable sub-sections of the contract specifications. Where a discrepancy may exist between any applicable sub-section and directions as contained herein, this section shall govern.

1.3 RELATED WORK

A. Division 08 - Door Hardware

B. Section 270000 – General Technology Requirements

C. Section 270500 – Communications General Requirements

D. Section 270526 – Grounding and Bonding for Technology Systems

E. Section 270528 – Pathways for Technology Systems

F. Section 270537 – Firestopping for Technology Systems

G. Section 271100 – Communications Equipment Rooms

H. Section 271500 – Communications Horizontal Cabling

I. Section 271600 – Communications Connecting Cords

J. Section 271800 – Communications Labeling and Identification

K. Section 275100 – Distributed Communications Systems

L. Section 276000 – Physical Security General Requirements

M. Section 276400 – Video Surveillance System

N. Section 276600 – Intrusion Detection System

1.4 DEFINITIONS

A. Refer to Section 270000 for additional definitions.

1.5 REFERENCE STANDARDS AND CODES

A. IEC 60839-11-5:2020 - Open Supervised Device Protocol (OSDP)

B. Refer to Section 270000 for additional requirements.

1.6 QUALIFICATIONS

A. Lock installers for fire-rated doors are to be trained and certified by the manufacturer via Intertek Qualified Personnel (IQP) Raceway and Hardware Installer Program on the proper installation and adjustment of fire, life safety, and security products in compliance with NFPA 80, including hanging devices; locking devices; closing devices; and seals.

1. Trained and qualified raceway installers are required to ensure modifications do not affect the integrity of fire doors. Doors must remain compliant with NFPA 80.

B. Refer to Section 270000 for additional requirements.

1.7 PRE-CONSTRUCTION SUBMITTALS

A. Contractor shall submit the access control hardware layouts, which include the number of controllers, sub-panels, and other associated devices per location.

B. Contractor shall submit full power calculations, which include the anticipated power loads, number, and type of power supplies, including all power supply boards, number of 120VAC circuits required, battery backup including the quantities of batteries to meet requirements, PoE loads, fire alarm connection requirements, etc.

C. Refer to Section 270000 and 276200 for additional requirements.

1.8 PRE-INSTALLATION PROCEDURES

A. For in-use, existing facilities or retrofit projects, Contractor shall assign all applicable electronics IP addresses, passwords, and pre-build out all the enclosures, including the interconnects within the enclosure, prior to being delivered to the project or installed.

B. Contractor shall cable all controlled or monitored doors, intercoms, etc., and terminate this cable in the access control panels no less than 3 weeks prior to substantial completion regardless of the status of the field devices such as door hardware, card readers, intercoms, etc.

C. Contractor shall program the access control system no less than 2 weeks prior to substantial completion so when field devices are installed and terminated, associated door hardware and full system functionality can be tested. Programming shall include all doors, associated inputs, outputs, and interoperability regardless of the final field device status.

D. Contractor shall perform final connections and testing onsite when field devices such as electrified door hardware have been installed.

E. Refer to Section 270000 for additional requirements.

1.9 CONSTRUCTION PROGRESS SUBMITTALS

A. Refer to Section 270000 requirements.

1.10 CLOSEOUT SUBMITTALS

A. Refer to Section 270000 for additional requirements.

PART 2 - PRODUCTS

2.1 SUBSTITUTIONS

A. Unless noted otherwise, products in this section are intended as a basis of design and are open to substitutions per the product substitution procedures defined in Section 270000.

2.2 ELECTRONIC ACCESS CONTROL HARDWARE

A. Open Options is the approved ACS. No alternates.

B. The Access Control Panel (ACP) is used as the subcomponent of the security management system for the purpose of initiating all decision-making criteria as it relates to the cardholders, readers, and associated hardware connected. Decisions are made by the ACP and uploaded to the host computer as historical events.

C. The ACP shall be listed for Underwriters Laboratory (UL):

D. UL294 (Access Control System)

E. Provide an access control system based off of HID Mercury Security open platform hardware and interface modules. The panels shall:

1. Operate without the need for the host to be online. No decisions shall be dependent on the host.
2. Support on-board 10/100 Ethernet communications to the host as primary communication.
3. Include a request-to-exit and door status contact input for each reader without the need for additional modules for future use.
4. Detect “forced entry” and “door left open.” A separate action is required for each.
5. Allow mapping of readers to any output address within the same controller.
6. Support at least 50 user-selected holidays.
7. Allow all unused door logic, such as door strike relays, request-to-exit inputs, and door status inputs, to be assigned as general-purpose points.
8. Support optional modules for additional customization of inputs and outputs.
9. Wireless intelligent lock support.
10. Wired intelligent lock support.
11. Elevator support.
12. Maintain historical information for a minimum of three (3) months without AC power.
13. Automatically adjust for daylight savings time and leap year.
14. Support a variety of reader technologies.
15. Support for OSDP V2 and OSDP V2 SC (Secure Channel).
16. Support the following card/reader technologies as a minimum:

    a. Magnetic Stripe
    b. 125KHz Proximity cards
    c. 13.56Mhz Smart Cards and technologies
    d. Biometrics
    e. Vehicle Identification
    f. Support multiple technologies simultaneously.
    g. Support for HID 37-bit card formats.
    h. Support for HID iClass SE and Seos technologies.
    i. Support for NXP and HID MiFare DESFire EV1, EV2, and EV3

17. Maintain the expiration date for each cardholder. Once the date is reached, the card will automatically be disabled. No access shall be authorized.
18. Maintain three (3) access times for each door location: Standard, Long, and Egress.
19. Have the ability to maintain an automatic door unlock during specific hours and days.

20. Support a minimum of (2) “levels” of Anti-Passback: Global and Area.
21. All controllers and expansion modules shall have the latest ACS-recommended firmware installed and shall have matching firmware versions. Contractor shall provide all necessary firmware upgrades to keep the Owner on the latest version throughout the duration of the project. At the completion of the project, the Owner shall have the option to receive a final firmware update to the latest version before the project is paid in full.

F. Panels shall use HID Mercury Security LP controllers with Series-3 MR interface panels. Legacy EP controllers and Series-2 interface panels are not allowed.

1. Contractor shall provide an adequate number of access control panels, controllers, door interface panels, and I/O panels for a complete turnkey system to support all components as indicated on project drawings, specifications, and as required.
2. Basis of design is LP1502 controllers, MR52-S3 interface panels, and MR16IN-S3/OUT-S3 I/O panels.
3. LP1501 Single door controllers shall only be used when specifically specified or approved by the Consultant. MR50 single door expansion modules shall not be utilized.
4. For RS-485 based intelligent lock installations, expansion module star topologies, or complex installations requiring significant RS-485 connection, Contractor shall utilize Mercury Security MUX8 RS-485 multiplexers.
5. Mercury Security Series-3 LP1501 Controller: Edge Controller and remote doors and Gates

    a. Power Input:

        1) PoE or PoE+
        2) Direct current (12VDC) ±10% 1800 mA maximum.

    b. Power Output:

        1) PoE powered - 12 Volts DC at 625mA, including reader and AUX output.
        2) PoE+ or 12 VDC powered - 12 Volts DC at 1250mA, including reader and AUX output.

    c. Reader Interface: 12VDC ±10%. PTC is limited to 300mA maximum per reader.
    d. Inputs: two general-purpose programmable circuit types and dedicated tamper.
    e. Outputs: two relays – Form-C, 2 Amp, 30 volts direct current
    f. Onboard Reader Ports: Supports 2 readers on up to 1 opening.
    g. RS-485 Bus: (1) RS-485 bus.
    h. OSDP Secure Channel support.
    i. LED: TTL, two wire or one wire bi-color support
    j. Buzzer: One-wire LED mode.
    k. Supports up to 1 OSDP reader nativity or up to 16 readers with downstream modules.
    l. Supports up to 130 inputs and 130 outputs with downstream modules.
    m. 240,000 cardholder capacity.
    n. Dimensions: 5.5” W x 2.75”H x 1.33”D with bracket. Fits within a 3-gang box.
    o. Provide with Mercury Security Series-3 MR52 or other SIO modules as necessary for the application when Mercury controllers are utilized.
    p. Provide with an appropriate, lockable enclosure to house the controller as well as the terminations and any expansion modules.

6. Mercury Security Series-3 LP1502 Controller:

    a. Power Input

        1) Direct current (12-24VDC) ±10% 500 mA maximum.

    b. Power Output: 12 Volts DC at 650mA, including reader and AUX output.
    c. Reader Interface: 12-24VDC ±10%. PTC limited to 300mA maximum per reader.
    d. Inputs: Eight general purpose programmable circuit types and dedicated tamper.
    e. Outputs: Four relays – Form-C, 2 Amp, 30 volts direct current
    f. Onboard Reader Ports: Supports 4 readers on up to 2 openings.
    g. RS-485 Bus: (1) RS-485 bus.
    h. OSDP Secure Channel support.
    i. LED: TTL, two wire or one wire bi-color support
    j. Buzzer: One-wire LED mode
    k. Supports up to 128 OSDP readers on up to 64 openings with downstream modules.
    l. Supports up to 520 inputs and 516 outputs with downstream modules.
    m. 240,000 cardholder capacity.
    n. 2gb to 8gb MicroSD card support.
    o. Dimensions: 8” W x 6”H x 1”D.
    p. Provide with Mercury Security Series-3 MR52 or other SIO modules as necessary for the application when Mercury controllers are utilized.
    q. Provide with an appropriate, lockable enclosure to house the controller as well as the terminations and any expansion modules.

7. Mercury Security Series-3 LP2500 Controller:

    a. Power Input

        1) Direct current (12-24VDC) ±10% 500 mA maximum.

    b. Inputs: None.
    c. Outputs: None
    d. Onboard Reader Ports: None.
    e. RS-485 Bus: (2) RS-485 buses.
    f. OSDP Secure Channel support.
    g. Supports up to 128 OSDP readers on up to 64 openings with downstream modules.
    h. Supports up to 1024 inputs and 1024 outputs with downstream modules.
    i. 600,000 cardholder capacity.
    j. 2gb to 8gb MicroSD card support.
    k. Dimensions: 5” W x 6”H x 1”D.
    l. Provide with Mercury Security Series-3 MR52 or other SIO modules as necessary for the application when Mercury controllers are utilized.
    m. Provide with an appropriate, lockable enclosure to house the controller as well as the terminations and any expansion modules.

8. Mercury Security Series-3 LP4502 Controller:

    a. Power Input

1) Direct current (12-24VDC) ±10% 550 mA maximum.

b. Power Output: 12 Volts DC at 650mA, including reader and AUX output.
c. Reader Interface: 12-24VDC ±10%. PTC limited to 300mA maximum per reader.
d. Inputs: Eight general purpose programmable circuit types and dedicated tamper.
e. Outputs: Four relays – Form-C, 2 Amp, 30 volts direct current
f. Onboard Reader Ports: Supports 4 readers on up to 2 openings.
g. RS-485 Bus: (2) RS-485 buses.
h. OSDP Secure Channel support.
i. LED: TTL, two wire or one wire bi-color support
j. Buzzer: One-wire LED mode
k. Supports up to 128 OSDP readers on up to 64 openings with downstream modules.
l. Supports up to 1024 inputs and 1024 outputs with downstream modules.
m. 2,000,000 cardholder capacity.
n. FICAM high-assurance credential authentication such as FIPS 201 HID pivCLASS.
o. BACnet IP communication Protocol compatible.
p. Embedded elevator destination dispatch capabilities.
q. 3rd party extended application support.
r. 2gb to 8gb MicroSD card support.
s. Dimensions: 8” W x 6”H x 1”D.
t. Provide with Mercury Security Series-3 MR52 or other SIO modules as necessary for the application when Mercury controllers are utilized.
u. Provide with an appropriate, lockable enclosure to house the controller as well as the terminations and any expansion modules.

9. Mercury Security Series-3 MR53-S3 Reader Expansion Module:

a. Power Input

1) Direct current (12-24VDC) ±10% 500 mA maximum.

b. Reader Interface: 12-24VDC ±10%. PTC limited to 300mA maximum per reader.
c. Inputs: Eight general purpose programmable circuit types and dedicated tamper.
d. Outputs: Six relays – Form-C, 2 Amp, 30 volts direct current
e. Onboard Reader Ports: Supports 4 readers on up to 2 openings.
f. Host Communication: RS-485
g. OSDP Secure Channel support.
h. LED: TTL, two wire or one wire bi-color support
i. Buzzer: One-wire LED mode
j. Dimensions: 6” W x 8”H x 1”D.

10. Mercury Security Series-3 MR16IN-S3 Input Expansion Module:

a. Power Input

1) Direct current (12-24VDC) ±10% 350 mA maximum.

b. Reader Interface: 12-24VDC ±10%. PTC limited to 300mA maximum per reader.
c. Inputs: Sixteen general purpose programmable circuit types and dedicated tamper.
d. Outputs: Two relays – Form-C, 2 Amp, 30 volts direct current

e. Onboard Reader Ports: None.
f. Host Communication: RS-485
g. Dimensions: 6” W x 8”H x 1”D.

11. Mercury Security Series-3 MR16OUT-S3 Output Expansion Module:

a. Power Input

1) Direct current (12-24VDC) ±10% 1100 mA maximum.

b. Reader Interface: 12-24VDC ±10%. PTC limited to 300mA maximum per reader.
c. Inputs: Two general purpose programmable circuit types and dedicated tamper.
d. Outputs: Sixteen relays – Form-C, 2 Amp, 30 volts direct current
e. Onboard Reader Ports: None.
f. Host Communication: RS-485
g. Dimensions: 6” W x 8”H x 1”D.

2.3 MAPPING SOFTWARE

A. The ACS software shall be provided with native integrated mapping software.

B. The mapping software shall be compatible with PDF, JPEG, and PNG.

C. The mapping software shall be licensed to use Microsoft Bing maps, Google Maps, Open Street Maps, or similar.

D. Contractor shall provide a satellite level screenshot map showing exterior devices. These maps shall include drill down links to access the building floor plans where all interior and exterior devices are shown. The overview satellite map shall show alarms signifying there is an alarm in the building to draw attention quickly.

E. Contractor shall be responsible for providing all the labor to set up these maps and place all the devices.

F. Contractor shall get a sign-off from the Owner and Consultant on the finished maps.

G. Contractor shall obtain the building plans from the Consultant for their use.

2.4 SURGE PROTECTION FOR LOW-VOLTAGE AC/DC POWER

A. Contractor shall provide a surge protector for all exterior devices being supplied by low-voltage power. This does not include devices directly connected to a building where the risks of surges are negligible.

B. There shall be a minimum of a 36” shielded cable from the surge protector to the device to allow for adequate clamping time.

C. When the protector is mounted in an interior, dry, or weather-sealed enclosure:

1. Nominal voltage rating of 24V AC/DC. Provide the correct module per the required voltage level if different from 24V.
2. 20,000A surge current rating.
3. Protects 2-pair per module.
4. Accepts up to 10AWG cable
5. Connect directly to ground.
6. UL 497B listed
7. Provide quantity of modules as required for the application.
8. Provide base mounting plate as required for the application.
9. Manufacturer:

    a. Ditek DTK-2MB Mounting Base
    b. Ditek DTK-2MHLP24B Surge Module

2.5 SURGE PROTECTION FOR 120 VAC POWER

A. Contractor shall provide a surge protector for all 120VAC supplied panels and enclosures when there is a critical risk of surges. This does not include interior panels, which only serve interior devices or devices connected directly to a building where the risks of surges are negligible.

B. There shall be a minimum of 36” of cable from the surge protector to the load to allow for adequate clamping time.

C. Exterior, enclosure, or other mounted:

1. Nominal voltage rating of 120VAC, single-phase, 20A continuous load.
2. Parallel connected.
3. 50,000 A surge current rating.
4. UL 1449 Type 1 SPD listed
5. LED indicator.
6. NEMA 4X rated.
7. Maintain a minimum of 3’ of cable from the surge protector to the load.
8. Manufacturer:

    a. Ditek DTK-120HW

D. Interior, wall mount:

1. Nominal voltage rating of 120VAC, single-phase, 20A continuous load.
2. Series connected.
3. 54,000 A surge current rating.
4. 35db of EMI/RFI filtering.
5. UL 1449 Type 2 SPD listed
6. UL 1289 EMI/RFI Noise Filtering listed.
7. LED indicator.
8. Form C dry contacts for remote monitoring.
9. Include with NEMA 4X enclosure.
10. Maintain a minimum of 3’ of cable from the surge protector to the load.
11. Manufacturer:

a. Ditek DTK-TSS4D

2.6 POWER SUPPLIES AND ACCESS CONTROL ENCLOSURES

A. Provide a power supply/chargers and sub-assemblies to power various access controller boards, locking hardware, and other access control or security system components. Contractor shall select the appropriate enclosure, power supply, and sub-assemblies for each application. Contractor shall include network monitoring modules for all power supplies.

B. Enclosures

1. Shall be capable of accommodating power supplies, sub-assemblies, and other manufacturers' access control controller boards when required.
2. Wall mountable.
3. Include a cam-lock and tamper switch.
4. Include with rocker switches to control power to the power supplies.
5. Life safety enclosures to house access control electronics along with power supply and distribution components.

C. Power Supplies

1. 115 VAC input
2. 12VDC or 24VDC selectable outputs at:

    a. 4-amp continuous power @ 12VDC or 24VDC.
    b. 6-amp continuous power @ 12VDC or 24VDC.
    c. 10-amp continuous power @ 24VDC.

3. High-capacity battery charging circuit.
4. Form “C” supervision contacts for AC Low, AC Fail, and battery presence.
5. Supervised Fire Disconnect.
6. Low power Disconnect.
7. Class 2 aux. output.
8. UL 294 listed sub-assembly for access control.
9. Furnish and install with power rocker switches for each power supply.

D. Batteries

1. Contractor shall provide a minimum of (2) 12V, 7ah, sealed Absorbent Glass Mat (AGM) style batteries with F style terminals per power supply.
2. Provide adequate battery backup as required by Authority Having Jurisdiction (AHJ) or a minimum of 4-hours.
3. Manufacturer:

    a. Interstate Power Patrol FAS1075
    b. Power Sonic PS-1270

E. Sub-Assemblies

1. Contractor shall provide all sub-assemblies to meet the project requirements
2. Access Control Module

    a. Independently controlled fused protected outputs:

        1) Fail-Safe and/or Fail-Secure power outputs.
        2) Dry form “C” 5 amp rated relay outputs (fused).
        3) Any combination of the above

3. Access Control System trigger inputs:

    a. Normally open (NO) inputs.
    b. Open collector sink inputs.
    c. Any combination of the above.

4. Fire Alarm Disconnect:

    a. Individually selectable for any or all outputs.
    b. Latching or non-latch input FACP disconnect.
    c. Normally open (NO), normally closed (NC) dry contact or polarity reversal from FACP signaling circuit trigger input.
    d. LED indicates that the Fire Alarm Disconnect has been activated.
    e. Form “C” relay output for auxiliary reporting.

5. Multi-Output Power Distribution Module

    a. Single input distributed over eight (8) outputs.
    b. Fused protected outputs.
    c. Output terminals shall accommodate up to 12AWG wires.

6. Multi-Output Power Distribution Module with Dual Inputs

    a. Two (2) inputs distributed over eight (8) outputs.
    b. Outputs shall be configurable by input.
    c. Fused protected outputs.
    d. Output terminals shall accommodate up to 12AWG wires.

7. Network Communication Modules

    a. Power Supply Network Interface

        1) Interface for up to two (2) eFlow power supply/chargers.
        2) Two (2) Network controlled From “C” relays.
        3) Event timers.

    b. Network Power Distribution Module

        1) Two (2) inputs distributed over eight (8) outputs.
        2) Outputs shall be configurable by input.
        3) Fused protected outputs.

4) Emergency disconnect interface by output.
5) Selectable battery back-up by output.
6) Output terminals shall accommodate up to 12AWG wires.

c. Common monitoring features

1) Network interface via LAN/WAN.
2) Centralized dashboard for monitoring all power supplies. Provide appropriate hardware/software required.
3) Remote reporting of status via email and/or SNMP trap messaging.
4) AC, low battery, and battery presence monitoring.
5) Alert messages of System Service required.
6) System log.
7) On demand determination of system status.
8) Reset of individual outputs as required for remote diagnostics.
9) Monitor enclosure temperature.
10) Static or DHCP IP address configuration.
11) SSL Secure Sockets Layer encryption.

8. Voltage Regulator

a. Contractor shall provide a voltage regulator to provide constant 5VDC or 12VDC outputs for access control boards, modules, or other applicable components, as well as a voltage regulator for door hardwiring or controllers requiring 12VDC.
b. 24vdc Input.
c. Selectable 5 or 12VDC output.
d. Output rating of 6amp max.
e. Stackable with both Networkable and dual input power distribution modules for space savings.

9. Power supplies and sub-assemblies shall be manufactured by Altronix :

a. eflow4NB - 4amp 12vdc/24vdc power supply (UL listed Sub-assembly).
b. eFlow6NB - 6amp 12vdc/24vdc power supply (UL listed Sub-assembly).
c. eFlow104NB - 10amp 24vdc power supply (UL listed Sub-assembly).
d. ACM8 - Eight (8) output, fused Access Control Module (UL listed Sub-assembly).
e. ACMS8 – Dual input, eight (8) output, fused Access Control Module (UL listed Sub-assembly).
f. Linq2 - Network Communication Module (UL listed Sub-assembly).
g. Linq8PD - Dual input, eight (8) output, fused Network Communication Module (UL listed Sub-assembly).
h. PDS8 - Dual input, eight (8) output, fused power distribution module (UL listed Sub-assembly).
i. VR6 - Voltage Regulator (UL listed Sub-assembly).
j. RSB2 – Rocker switches with mounting bracket.

2.7 CABLING

A. Provide cabling per manufacturer's recommendations and code requirements for riser rated, plenum, and non-plenum cable types.

B. UTP data cabling required will be provided, installed, terminated, and tested by the Division 27 structured cabling Contractor.

C. UTP patch cables will be provided and installed by the Owner in the IDF and provided by the Owner and installed by Contractor at the door. The EACS Contractor shall provide the Owner with a list of patch cable lengths at the door side.

D. Wiegand cables for electronic access-controlled doors shall be a composite bundled cable and include the following cables and conductor counts:

1. Card reader, Wiegand – 6 conductor, 22 awg shielded.
2. Lock power – 4 conductor, 18 awg unshielded.
3. Door contact – 2 conductor, 22 awg unshielded. Furnish and install a second 22 awg, 2-conductor cable when the door contact connects to both the access control system and intrusion detection system.
4. Request to exit and/or latch detection/spare – 4 conductor, 22 awg unshielded
5. Manufacturer (Wiegand):

    a. Belden (Wiegand) #658AFS
    b. General Cable (Wiegand) #4EPL1S
    c. Superior Essex (Wiegand) #AC-A1x-68
    d. West Penn #AC251822B
    e. Color yellow.

E. OSDP cables for electronic access-controlled doors shall be a composite bundled cable and include the following cables and conductor counts:

1. Card reader, OSDP – 2 conductor stranded, twisted, 24 awg, 100% foil shield with 90% tinned copper braid shield with drain, 120-ohm nominal impedance, 12.5 pF/ft capacitance, designed for RS-485.
2. Card reader power - 2 conductor, 18 awg unshielded, may be within same jacket as card reader cable.
3. Lock power – 4 conductor, 18 awg unshielded. Provide larger 16-awg when required due to distances and current draw.
4. Door contact – 2 conductor, 22 awg unshielded. Furnish and install a second 22 awg, 2-conductor cable when the door contact connects to both the access control system and intrusion detection system.
5. Request to exit and/or latch detection/spare – 4 conductor, 22 awg unshielded
6. Manufacturer (OSDP):

    a. Belden – #TBD
    b. Sterling Wire and Cable - #SWC-8920A (Basis of design with 16-awg lock conductors)
    c. Paige Datacom - #236700807
    d. Remee Wire & Cable - #725937

e. Windy City Wire - #4461030-OSDP
f. Color Yellow

F. Cables for RS-485/OSDP in panel or in panel controller shall be 2 conductor stranded, twisted, 24 awg, 100% foil shield with 90% tinned copper braid shield with drain, 120-ohm nominal impedance.

1. Manufacturer:

a. Belden #82841

G. RS-485/OSDP cables for electronic access-card reader only doors not requiring composite cabling such as secondary/daisy-chained OSDP card readers, remote controllers, or RS-485 based intelligent locks, hubs, or gateways shall be:

1. Card reader, OSDP – 2 conductor stranded, twisted, 24 awg, 100% foil shield with 90% tinned copper braid shield with drain, 120-ohm nominal impedance, designed for RS-485.
2. Card reader/Device power - 2 conductor, 18 awg unshielded
3. Manufacturer (OSDP):

a. Belden 6381MD
b. Sterling Wire & Cable # S182241PRS-10
c. West Penn # 1PR2418P

H. Exterior OSDP cables for the exterior electronic access-card reader only doors not requiring composite cabling shall be:

1. Card reader, OSDP – 2 conductor stranded, twisted, 24 awg, 100% foil shield with 90% tinned copper braid shield with drain, 120-ohm nominal impedance, designed for RS-485.
2. Card reader power - 2 conductor, 16 awg unshielded
3. Manufacturer (OSDP):

a. West Penn # 1PR485D+

I. Cables for controlled doors shall be 16-gauge, 2-conductor, unshielded, stranded cable per controlled door. The cable shall be white in color and plenum rated.

J. Cables for intercom trigger wires, door release buttons, and panic/lockdown buttons shall be 18-gauge, four-conductor, unshielded, stranded cable. The cable shall be white in color and plenum rated.

K. Cables for intercom trigger wires or door contacts shall be 18-gauge, four-conductor, unshielded, stranded cable. The cable shall be white in color and plenum rated.

L. Cables for magnetic door hold opens shall be 18-gauge, two-conductor, unshielded, stranded cable. The cable shall be white in color and plenum rated.

M. Cables for key switches shall be 18-gauge, 4-conductor, unshielded, stranded cable. The cable shall be white in color and plenum rated.

N. Cables for emergency strobes shall be no smaller than 18-gauge and shall be increased in size up to 12-gauge as voltage drop, distance, and the total circuit capacity requires.

O. Cables for PoE locks shall be installed by the Division 27 cabling Contractor. Horizontal cable shall be terminated above the door within a j-box to provide a disconnect point for the patch cable to the PoE hinge.

2.8 DOOR CONTACTS/DOOR POSITION SWITCHES (DC)

A. All doors with card readers and all doors shown for monitor only shall have a door position switch. When the door position switches are not shown in the Division 08 specifications, the Security Contractor shall furnish and install them. The Security Contractor shall be responsible for the connection of all door position devices to the access control system and other systems if sharing the same door position switch. Door position devices shall be integral to the door hardware whenever possible. Contractor shall refer to the door hardware schedule and coordinate with the door hardware Contractor on locations and requirements.

B. Sealed and potted magnetic reed switch in contact housing.

C. Provide DPDT for applications with multiple security systems (Access Control/Intrusion Detection) utilizing a single door contact.

D. Door contacts shall be appropriately sized for any established holes within door frames.

E. Parts provided are basis of design. Determination of the final part number is the responsibility of Contractor.

F. Provide color that matches door as close as possible.

G. Provide recessed switch whenever possible.

H. Provide armored whip for surface mount contacts.

I. Provide with a 1k/2k end of line (EoL) pre-built resistor pack. GRI (George Risk Industries, Inc.) 6644 series.

J. Provide GRI (George Risk Industries, Inc.) 180 Series for recessed applications.

1. Magnasphere
2. Nascom

K. Provide GRI (George Risk Industries, Inc.) 4400 series for surface mount applications.

1. Magnasphere
2. Nascom

L. Provide GRI (George Risk Industries, Inc.) MC-180 Series for hollow top channel applications.

1. Magnasphere

2. Nascom

M. Provide GRI (George Risk Industries, Inc.) 4532 Series for overhead door applications.

1. Magnasphere
2. Nascom.

2.9 REQUEST TO EXIT (REX) DEVICES

A. All doors with card readers shall have a request to exit, with the exception of doors with a card reader in and a card reader out. When the integrated request to exit devices are not shown in the Division 08 specifications, the security Contractor shall furnish and install motion-based request to exit devices. The Security Contractor shall be responsible for the connection of all requests to exit devices integral to the door, motion based or other to the access control system. Request to Exit devices shall be integral to the door hardware whenever possible. Contractor shall refer to the door hardware schedule and coordinate with the door hardware Contractor on locations and requirements. Motion-based Request to Exit devices shall only be used when not available in the door hardware.

B. Provide with a 1k/2k end of line (EoL) pre-built resistor pack when utilized to release doors with magnetic locks or other high security applications. GRI (George Risk Industries, Inc.) 6644 series.

C. Independent adjustable beam pattern.

D. Provide with mounting plate or wall mounting plate to mount over a single-gang backbox when required.

E. Provide white or black color that matches the door as closely as possible.

F. (2) Form C relay contacts, each rated 1 A at 30 VAC or VDC for resistive loads.

G. DC Power draw: 39mA max @ 12 VDC.

H. Dimensions : 1.8”H x 6.75”W x 1.75”D.

I. Utilize contact closure REX hardware built into the handle or crashbar whenever possible.

J. Allegion hardware per division 8

K. Provide Bosch DS160/161

1. Provide with TP160/161 mounting plate when mounted over a backbox.
2.

2.10 ELECTRIFIED HARDWARE (EH)

A. The Security Contractor shall be responsible for the connection of all electrified hardware to the access control system. This shall include providing centralized power supplies located next to or

integral to the access control panels. Contractor shall coordinate with the door hardware specifications and schedules for additional information.

B. Allegion as per division 8

2.11 ADA POWER ASSIST DOOR OPERATOR INTEGRATION RELAYS

A. Only if division 8 specifies it and refers to this section.

B. Contractor shall provide all necessary relays to interface to the ADA operators at access-controlled doors with ADA door operators. The ADA operator interface shall be managed by the access control system. Local “smart relays” are not allowed.

C. Hardwired paddles

1. Provide with a DPDT relay. Replace the existing relay in the paddle, as necessary.
2. Manufacturer:

    a. Altronix RB1224

D. Wireless paddles

1. Provide with DPDT wireless relay transmitter and receiver. Replace the existing relay in the paddle, as necessary.
2. Manufacturer:

    a. Larco Atek 234475 transmitter and Larco Atek 233804 receiver

2.12 DOOR RELEASE BUTTON, UNDER COUNTER

A. SPDT, momentary push button

B. Guard ring around the button to prevent accidental activation

C. Mount with the button facing the back of the desk

D. Coordinate the exact mounting location after the deck or counter is fully complete and the sitting position has been decided.

E. Manufacturer:

1. Alarm Controls TS-18

2.13 PANIC/DURESS/LOCKDOWN BUTTONS

A. Exact device type and style are to be coordinated with Owner prior to approval or purchase. A selection of button options shall be presented to the Owner for review.

B. Button shall be hardwired.

C. Provide with a 1k/2k end of line (EoL) pre-built resistor pack. GRI (George Risk Industries, Inc.) 6644 series.

D. Buttons within a single space may be wired in parallel and be programmed as a zone.

E. Manufacturer:

1. Under desk – Honeywell 269R
2. Wall push type – STI-USA Stopper Station #SS2432LD-EN

a. Blue, flush cover, latching with key to unlock, Text = LOCKDOWN. Coordinate exact text to use with Owner prior to purchase. Provide with appropriate power supply connection for illumination.

F. Include a minimum of $50 per device allowance to select a button style during the project based on each location's needs.

2.14 IP SIP SINGLE/DUAL/QUAD BUTTON INTERCOM WITH INTEGRATED IP CAMERA

A. Exterior rated with vandal-proof housing.

B. 1, 2, or 4 illuminated programmable buttons capable of calling one, two, or four different extensions.

C. NEMA 4X, IP 69 rated.

D. IK10 impact resistance rated.

E. PoE or 12 VDC powered.

F. (2) relays for device control and monitoring. Output shall be connected to the access control system headend for remote door unlock via DTMF.

G. QoS support. Contractor shall configure the unit for QoS and use a DSCP value of 46 for audio and 32 for streaming video.

H. Supports NTP time synchronization. Contractor shall coordinate with the Owner to obtain the NTP IP address to configure the unit.

I. Contain a built-in web server making video and configuration available to multiple clients in a standard operating system and browser environment using HTTP, without the need for additional software.

J. Be equipped with an integrated event functionality, which can be triggered by video motion detection, button press, DTMF, audio, schedule, camera tampering, embedded third party applications, external input, audio detection, edge storage disruption detection, etc. The camera

shall provide memory for pre & post alarm recordings. Event functions shall be configurable via the web interface.

K. IEEE 802.1X (Authentication) compliant.

L. Provide with appropriate surface mount backbox based on field conditions. Do not recess mount.

M. TR069 capable with cloud monitoring and provisioning service.

N. Provide an additional 22awg, 2-conductor cable from the access control headend to each intercom for door unlock integration.

O. Integrated Intercom specifications:

1. SIP VoIP compliant
2. Supports peer to peer mode.
3. Support multiple profiles for SIP mode and peer to peer mode. Contractor shall set up a peer-to-peer profile for direct communication to a SIP enabled VoIP video phone intercom master station.
4. Capable of dialing up to 3 independent extensions for group or rollover.
5. 2-way, full duplex audio
6. AAC-LC audio encoding @ 16 kHz.
7. 94db audio output over the integrated speaker.
8. Built-in echo cancellation and noise reduction.

P. Integrated camera specifications:

1. Be designed to provide at least two simultaneous video streams in all resolutions, simultaneous including a SIP video stream, at a selectable range up to 30 frames per second (60Hz mode) using H.264 or MJPEG.
2. Support the following video resolutions: 160x90 to 640x480.
3. 135 degrees horizontal by 109 degrees vertical field of view.
4. Integrated LED for illumination.
5. ONVIF Profile S compliant.
6. Provide with (1) Video Management System license per intercom to record the integrated camera.

Q. Manufacturer and Model:

1. TID-600R - Hanwha Video Intercom
2. AIPHONE equivalent

2.15 DOOR LOOPS (POWER TRANSFER LOOPS)

A. Only if division 8 specifies it and refers to this section.

B. Provide new power transfer loops at the top of the doors for retrofit applications.

C. Provide all necessary materials and labor to connect existing electrified panic hardware and new access control system where appropriate.

D. Power transfer loop shall be armored stainless steel door loop with metal end caps.

E. Minimum interior diameter of 3/8” and exterior diameter of 1/2”.

F. Field verify the lengths required for each door.

G. Provide RCI #9508.

PART 3 - EXECUTION

3.1 PHYSICAL SECURITY SYSTEMS AND INTERCOM INTEGRATION

A. The electronic access control system shall be integrated with the video surveillance system and intrusion detection system.

1. The access control/intrusion detection interface shall be via an Ethernet interface. Contact closure integration shall only be utilized if the system is existing and cannot be upgraded to Ethernet. Contractor shall supply all necessary expansion boards if contact closure integration will be required.
2. The access control/video surveillance integration shall be via a native IP interface.
3. The video surveillance /intrusion detection interface shall be via an Ethernet interface.

B. Contractor shall provide any and all licensing to integrate the systems together, including any additional items to be added to the yearly maintenance agreement.

C. The following minimum features shall be included in the integration; the following list is not all-inclusive or exhaustive. The integration shall be a turnkey solution:

1. Call up live and/or recorded video from an alarm or event.
2. Graphical maps showing camera icons.
3. “Mouse over” camera viewing through the VMS browser and graphical maps.
4. Playback controls for recorded video.
5. Camera names brought in from the VMS.
6. PTZ camera mouse control.
7. Database entries for intrusion arm/disarm events on individual keypads.
8. Database entries for intrusion alarm events.
9. Graphical map symbols for intrusion keypads tied to camera views.
10. Intrusion devices or zones tied to camera views.
11. Alarm pop-ups and events shall include instructions and a sequence of operations to deal with events on the Intrusion Detection System, Video Management System, and Electronic Access Control System.
12. Intercom pop-ups when the call button is pressed with the ability to unlock the door.
13. Time syncing via common NTP server.

D. Contractor shall set up a meeting between the Owner, Consultant, and manufacturer to determine the exact functionality of the integration before the integration starts.

3.2 SYSTEM PROGRAMMING

A. Contractor shall provide all programming necessary for a turnkey system.

B. Programming shall include but not limited to setting all required IP addressing, setting passwords, firmware upgrades, adding the devices into the software, partitioning, area/zone creation, device naming, mapping, cross system integration, schedules, basic card holder groups, access levels, etc.

C. Contractor shall be responsible for temporary schedules, card holder groups, access levels, etc., required to make a building functional for certificate of occupancy requirements or basic facility use.

3.3 SYSTEM PARTITIONING, ZONING, AND NAMING

A. Contractor shall program each facility to be in its own partition. Some facilities may require sub-partitions to control user access to certain areas. Each manufacturer may use different names for partitions, zones, areas, etc. Adapt as required.

B. All devices, inputs, outputs, and other applicable software/hardware entities shall be named by Contractor, which includes naming at the administration/interface level in addition to the user facing interface.

C. As a basis to start, the following partition, zoning, and naming shall be followed:

1. Partition: Building name

    a. Zone 1: Building name and zone name such as exterior, 1st floor, etc.

        1) Device 1: Building name and floor/zone name - Door # or device name
        2) Device 2: Building name and floor/zone name - Door # or device name
        3) Repeat as required

    b. Zone 2: Building name and zone name such as 2nd floor, etc.

        1) Device 1: Building name and floor/zone name - Door # or device name
        2) Device 2: Building name and floor/zone name - Door # or device name
        3) Repeat as required

    c. Repeat zones as required.

2. Repeat Partitions as required.

D. The Owner shall have the final say. Contractor shall schedule a coordination meeting with the Owner and Consultant to coordinate actual project structure and naming prior to starting any programming.

3.4 INSTALLATION PROCEDURES

A. Contractor shall cable all controlled or monitored doors, intercoms, etc., and terminate this cable in the access control panels no less than 3 weeks prior to substantial completion regardless of the status of the field devices such as door hardware, card readers, intercoms, etc.

B. Contractor shall program the access control system no less than 2 weeks prior to substantial completion so when field devices are installed and terminated, associated door hardware and full system functionality can be tested. Programming shall include all doors, associated inputs, outputs, and interoperability regardless of final field device status.

C. Contractor shall perform final connections and testing onsite when field devices such as electrified door hardware have been installed.

3.5 ADA POWER ASSIST DOOR OPERATOR INTERFACE

A. Only if required by Division 8.

B. Certain electric locking mechanisms with card access shall be connected (hardwired) to the ADA Power Assist Door Operator pushbutton. In this scenario, card reader shall be interfaced to the ADA Door Operator pushbutton to approve activation of door motor based on card authorization or pre-programmed security schedule.

C. Door motor/operator shall not be energized until authorized by the security system to prevent operation and eventual burn-out of the motor from hitting the button with the security system activated.

D. The door shall allow free egress via push paddle regardless if the door is in a locked or unlocked state.

E. The paddles and operators shall be tied through the access control system so the actions appear in the device trees, are mappable, logged, and can be scheduled or overridden.

F. Contractor shall provide all necessary cable, hardware, relays, I/O modules, interfaces, and system programming to support all necessary functionality.

G. All logic and programming shall be controlled through the access control system. Local logic boards, smart relays, etc., shall not be utilized.

3.6 DOOR RELEASE BUTTONS

A. Door release buttons shall be tied through the inputs of the access control system.

B. The button release shall be interfaced in a way that the actions appear in the device trees, are mappable, logged, and can be scheduled or overridden.

C. Contractor shall provide all necessary cables, hardware, relays, I/O modules, interfaces, and system programming to support all necessary functionality.

3.7 INTERCOMS AND REMOTE INTERCOM RELEASE

A. Contractor shall configure the intercoms and intercom master stations for point to point/multi-point communication with call rolling.

B. Contractor shall update the Android interface on the Grandstreams phones with the provided file. Coordinate with the Consultant. All firmware shall be upgraded to a specific version for compatibility with the interface.

C. Speed dial shortcuts for all intercoms shall be added to the home screen on the Grandstreams.

D. Remote intercom release relays shall be tied through the inputs of the access control system.

E. The intercom release shall be interfaced in a way that the actions appear in the device trees, are mappable, logged, and can be scheduled or overridden.

F. Contractor shall provide all necessary cables, hardware, relays, I/O modules, interfaces, and system programming to support all necessary functionality.

3.8 PANIC/DURESS BUTTONS

A. Panic/Duress buttons shall be tied through dedicated inputs of the access control system.

B. The buttons shall be interfaced in a way that the actions that appear in the device trees are mappable and logged.

C. When a panic/duress button is activated, an event to action shall occur, notifying client workstations. These alarms shall be activated on a map with a clear red flashing icon. Any associated or integrated cameras shall pop-up.

D. Additional actions may be required and shall be coordinated with the Owner and Consultant.

E. Contractor shall provide all necessary cables, hardware, relays, I/O modules, interfaces, and system programming to support all necessary functionality.

3.9 END OF LINE SUPERVISION

A. Contractor shall furnish and install end-of-line resistors to provide end-of-line supervision on all access control input devices. This shall include but is not limited to door position switches, request-to-exit devices, door release buttons, and duress/panic buttons.

B. Contractor shall furnish and install resistors as near to the field device as possible. Supervision resistance values shall be natively compatible with the associated control panel.

1. Mercury Security based installations shall utilize 1K resistors to provide a 1K / 2K ohm resistance values from associated inputs.

3.10 PASSWORDS

A. Contractor shall coordinate a secure project password with the Owner and Consultant. This password shall be documented by Contractor and used for all devices.

3.11 TESTING

A. Refer to Section 270000 for additional requirements.

B. Prior to energizing or testing the system, ensure the following:

1. All products are installed in a proper and safe manner per the manufacturer's instructions.
2. Dust, debris, solder, splatter, etc., is removed.
3. Cable is dressed, routed, and labeled; connections are consistent with regard to polarity.
4. All products are neat, clean, and unmarred, and parts are securely attached.

C. Contractor shall ensure that each device in the security system is functioning normally and in such a manner as to meet the functional and performance requirements in this specification.

3.12 TRAINING

A. Refer to Section 270000 for additional requirements.

B. Provide system operations, administration, and maintenance training by factory-trained personnel qualified to instruct.

1. Contractor shall provide up to 6 hours of scheduled and dedicated training time in three (3) two (2) hour sessions for administration and investigation.
2. Contractor shall provide up to 2 hours of dedicated training time for badge creation, printing, and printer maintenance.
3. Provide printed training materials for each trainee, including product manuals, course outline, workbook or student guides, and written examinations for certification.
4. Provide hands-on training with operational equipment.
5. Training shall be oriented to the specific system being installed under this contract as designed and specified.
6. Contractor shall provide all necessary documentation of system operating parameters prior to scheduled training sessions.

3.13 WARRANTY

A. Refer to Section 270000 for additional requirements.

3.14 INSTALLATION PRACTICES

A. All services provided shall be professional and conform to the highest standards for industry practices. The Owner reserves the right to halt any installation due to poor workmanship. All work shall be defect free, and the installer shall replace, at their expense, any work found to be defective.

B. The Owner reserves the right to halt any installation due to failure of Contractor to observe installation-free periods due to instructional or administrative requirements. To the maximum extent possible, the Owner will provide advance notice of such periods.

C. Contractor is responsible for providing a complete end system.

D. All manufactured items, materials, and equipment shall be applied, installed, connected, erected, used, and adjusted as recommended by the manufacturers or as indicated in their published literature unless specifically noted herein to the contrary.

E. Contractor shall follow these standards and approved submittals for locations of power supplies. The Owner intends to limit the number and location of power supplies to facilitate more effective long-term support and maintenance of the system.

F. Installation of locks on fire rated doors that require any modification or drilling of the door shall be done in accordance with the NFPA by a properly qualified and certified installer. The doors field WH-ETL labeling shall be properly updated.

3.15 COORDINATION

A. Contractor shall provide up to 8 hours (up to four, 2-hour sessions) of scheduled and dedicated coordination time to assist Owner with sequence of operation, rule creation, and coordination as requested by Owner or Consultant.

3.16 AESTHETICS

A. All cables and equipment terminating at panels frames shall be vertically straight, with no cables crossing each other, from twelve inches inside the ceiling area to the termination block.

B. All cable bundles shall be combed and bundled to accommodate individual termination block rows and panels.

C. For any given telecom room, a horizontal and vertical alignment for all mounting hardware will be maintained to provide a symmetrical and uniform appearance to the distribution frame.

D. All surface-mounted devices shall be firmly secured level and plumb

E. All rack mount equipment shall be securely installed.

3.17 HARDWARE LAYOUT

A. Hardware positioning and layout shall be reviewed and approved by the Owner prior to construction. The review does not exempt Contractor from meeting any of the requirements stated in this document.

3.18 SERVER INSTALLATION PRACTICES

A. Verify that the manufacturer approved server hardware OS meets the Owner's IT standards prior to ordering.

B. Coordinate server power, cooling, and mounting requirements with Owner prior to installation.

C. Coordinate virus scan/security software requirements with Owner and manufacturer prior to installation.

3.19 DEVICE CABLING/WIRING INSTALLATION PRACTICES

A. All external wires and cables shall be supported at least every five feet from the structure or as required to maintain not more than 12" cable sag between supports and without over tensioning the cables. Provide j-hooks as needed where cable tray or raceway is not available.

B. This Contractor shall coordinate installation with Division 27 cabling to ensure there are at least 2-inches of physical separation between security cabling and voice/data cabling throughout cable path. Voice/data cabling Contractor has first claim to cable tray.

C. All cables, regardless of length, shall be labeled within 18" of both ends with an identifier that is keyed to the door, room, or corridor number as identified.

D. All cables shall have 6-foot service loops neatly coiled in the equipment room. During initial cable rough-in, this Contractor shall have sufficient slack to route anywhere within the equipment room.

E. Cabling shall be adequately supported with Velcro wire wraps and horizontal support cable managers fastened to rack frame. Cables shall be dressed in a neat and orderly fashion. Any cabling or equipment installation that is deemed unacceptable by the Owner or Consultant shall be replaced or corrected by Contractor at no additional cost. Plastic zip ties are not allowed.

F. All cables are to run at right angles to the structure, placed above the ceiling in halls or corridors.

G. Cables shall not run above red iron joist.

H. Contractor shall make every effort to conceal wiring and other apparatus into walls, floors, and ceilings, assuming code and good engineering practice allows and suggests.

I. Ties and straps shall be installed snugly without deforming cable insulation. Ties shall be spaced at uneven intervals, not to exceed four feet. No sharp burrs shall remain where excess length of the cable tie has been cut.

J. Contractor shall notify Owner immediately if obstruction or hazard is discovered in a pathway provided by others.

K. Cable shall be stored and handled to ensure that it is not stretched, kinked, crushed, or abraded in any way. Bend radiuses shall meet manufacturer specifications and/or recommendations. Cable shall not be installed in ambient temperatures or moisture conditions above or below the manufacturer's rating.

L. No splices shall be installed in any cable.

3.20 CABLE TERMINATION

A. Termination hardware (blocks and patch panels) positioning and layout shall be reviewed and approved by the Owner prior to construction. The review does not exempt Contractor from meeting any of the requirements stated in this document.

3.21 FIRE STOPPING

A. Fire stopping of openings between floors, fire-rated walls, and smoke-rated walls created by others for Contractor to pass the cable through shall be the responsibility of Contractor. Sealing material and application of this material shall be accomplished in such a manner that is acceptable to the local fire and building authorities having jurisdiction over this work.

B. Any openings created by or for this Contractor and left unused shall be sealed up by this Contractor.

C. This Contractor shall be responsible for creating a waterproof seal in and around any openings that Contractor creates from the structure to the outside environment.

3.22 SYSTEM INSPECTION

A. Contractor shall coordinate with project representative for inspection after the Contractor has completed testing of entire system.

B. Contractor shall have trained Contractor representative and testing equipment on site during inspection to assist with spot verification of tests.

3.23 LABELING

A. Contractor shall neatly label all security devices and cabling at both ends. All labels shall be on Project as-built drawings.

3.24 DOCUMENTATION

A. Upon completion of the installation, Contractor shall provide full documentation sets to the Consultant for approval as described in section 276000. All documentation shall become the property of the Owner.

B. Documentation shall include the additional specific items detailed in the subsections below:

1. Contractor shall provide hard copy and electronic forms of the final test results.
2. Contractor shall provide a document including the following:

    a. Door label/identifier
    b. Location of each drop by orientation/permanent landmark in the room
    c. Contractor shall provide accurate as-built Construction Drawings. The drawings are to include cable routes and device locations.

3.25 PRE-CHECK OUT

A. Contractor shall demonstrate the following to Owner during system demonstration.

1. The card readers are fully installed and functional.

3.26 FINAL ACCEPTANCE

A. In addition to closeout requirements in section 276000, Contractor shall demonstrate the following before final approval.

1. Owner training is complete.
2. Punch list items are complete.
3. As-built documentation is complete and submitted to Owner/Consultant.

3.27 FINAL PROCEDURES

A. Perform final procedures in accordance with section 276000.

END OF SECTION 276200

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SECTION 276400 - VIDEO SURVEILLANCE SYSTEM

PART 1 - GENERAL

1.1 SCOPE

A. Refer to Section 270000 for additional project scope information.

B. Cameras will integrate with OpenOptions and Bosch. Contractor is to provide mapping and macros to automate alarms.

C. All cameras must have the proper bracket and support. Wall cameras must have wall brackets, etc.

D. Existing systems/devices being demolished to be returned to owner for first right of refusal.

1.2 PRECEDENCE

A. Obtain, read, and comply with General Conditions and applicable sub-sections of the contract specifications. Where a discrepancy may exist between any applicable sub-section and directions as contained herein, this section shall govern.

1.3 RELATED WORK

A. Section 270000 – General Technology Requirements

B. Section 270500 – Communications General Requirements

C. Section 270526 – Grounding and Bonding for Technology Systems

D. Section 270528 – Pathways for Technology Systems

E. Section 270537 – Firestopping for Technology Systems

F. Section 271100 – Communications Equipment Rooms

G. Section 271500 – Communications Horizontal Cabling

H. Section 271600 – Communications Connecting Cords

I. Section 271800 – Communications Labeling and Identification

J. Section 275100 – Distributed Communications Systems

K. Section 276000 – Physical Security General Requirements

L. Section 276200 – Electronic Access Control System

M. Section 276600 – Intrusion Detection System

1.4 DEFINITIONS

A. Refer to Section 270000 for additional definitions.

1.5 REFERENCE STANDARDS AND CODES

A. Refer to Section 270000 for additional requirements.

1.6 QUALIFICATIONS

A. Refer to Section 270000 for additional requirements.

1.7 PRE-CONSTRUCTION SUBMITTALS

A. Refer to Section 270000 for additional requirements.

1.8 PRE-INSTALLATION PROCEDURES

A. For in-use, existing facilities or retrofit projects, Contractor shall assign all applicable electronics IP addresses and secure passwords prior to being delivered to the project or installed. Confirm password with Owner and Consultant prior to setting them.

1.9 CONSTRUCTION PROGRESS SUBMITTALS

A. Refer to Section 270000 for additional requirements.

1.10 CLOSEOUT SUBMITTALS

A. Refer to Section 270000 for additional requirements.

1.11 GENERAL SUMMARY

A. System shall include IP cameras and a server-based NVR with client stations and storage as described in this section and on the drawings.

B. The Green Category 6A cabling to each camera shall be provided by the structured cabling Contractor. Patch cords for the IP cameras to the network switches shall be furnished by Contractor and installed by the Owner with participation by this Contractor under 271500. Patch

cords from the IP Camera to the data jack shall be furnished by this Contractor and installed by Contractor under 271500.

C. System installation shall include, but not be limited to, installation, programming, and configuration of system components as well as all associated software upgrades, patches, and maintenance for the first year.

D. Contractor is responsible for meeting with Owner's representative at time of camera installation to verify exact placement and view of each camera to ensure coverage area is as intended.

1.12 DRAWING SHEETS

A. All cameras are designated with a C symbol on the project drawings. PTZ (Pan Tilt Zoom) cameras are designated with PTZ text next to the C symbol. Each camera has a corresponding label of the format "*#-##."

B. New cameras and Category 6A cabling shall be provided at each location with a label "MDF or IDF # camera number, patch panel, and port #

1.13 MOUNTING AND INSTALLATION

A. Contractor shall provide the appropriate mounting hardware for all ceiling types and wall types where cameras shall be located. Plastic anchors are not allowed.

B. Wall mounted 180/360 degree, or multi-sensor cameras shall be mounted horizontally on a wall arm, gooseneck, parapet, pendant, or other similar method.

C. Exterior cameras shall be mounted on a wall arm/gooseneck.

D. Cameras mounted in droptile shall have a tile support bridge with a steel support cable connected to structure to prevent tile sagging, theft, and vandalism. Utilizing toggle bolts or other screw in anchors is not allowed.

1.14 CODE AND STANDARD REQUIREMENTS

A. All work and materials shall conform in every detail to the rules and requirements of the National Fire Protection Association and any other codes as required by the AHJ.

B. All materials shall be listed by UL and shall bear the UL label. If UL has no published standards for a particular item, then other national independent testing standards shall apply, and such items shall bear those labels. Where UL has an applicable system listing and label, the entire system shall be so labeled.

C. Cameras shall meet the following standards:

1. MPEG-4:

a. ISO/IEC 14496-10 AVC (H.264)

2. Networking:

    a. IEEE 802.3af (Power over Ethernet)

3. Network Video:

    a. ONVIF Profile S or better

PART 2 - PRODUCTS

2.1 SUBSTITUTIONS

A. Unless noted otherwise, products in this section are intended as a basis of design and are open to substitutions per the product substitution procedures defined in Section 270000.

2.2 MAPPING SOFTWARE

A. The VMS software shall be provided with native integrated mapping software.

B. The Contractor shall provide a satellite-level screenshot map showing exterior devices. These maps shall include drill-down links to access the building floor plans where all interior and exterior devices are shown. The overview satellite map shall show alarms signifying there is an alarm in the building to draw attention quickly to the correct building floor plan.

C. The maps shall have links to the other levels/sections as well as the global map.

D. All cameras shall show their approximate field of view.

E. The cameras shall change state when motion is detected.

F. The floor plans shall include all access-controlled doors and integrated devices.

G. Contractor shall be responsible for providing all the labor to set up these maps and place all the devices.

H. Contractor shall get a sign-off from the Owner and Consultant on the finished maps.

I. Contractor shall obtain the building plans from the Consultant for their use.

2.3 CAMERAS AND DEVICES

A. General:

1. All cameras and devices shall be time synced to the Owner’s NTP server. Coordinate with the Owner to acquire the appropriate NTP address to use.
2. Contractor shall coordinate with the owner for IP addressing, network configuration, QoS, and multicast network configuration.

3. Contractor shall enable QoS on all cameras and intercoms for the video stream, audio stream, event/alarm data, management, and metadata at the Owner's request.
4. The system shall be configured for multicast. All cameras shall have a multicast Time To Live (TTL) setting of at least 64.
5. Contractor shall select the appropriate mounting hardware for the situation.
6. All cameras shall be equipped with remote autofocus or auto back focus, with the exception of fixed lens 180/360-degree cameras and encoded analog cameras.
7. Multi-sensor 180 and 360 cameras shall have each sensor optimally calibrated independently to the conditions.
8. All cameras shall be vandal-proof and appropriate for the environment it is being installed in.
9. All cameras and devices shall have the latest VMS-recommended firmware installed, and all cameras of the same model shall have matching firmware versions. Contractor shall provide all necessary firmware upgrades to keep the Owner on the latest version throughout the duration of the project. At the completion of the project, the Owner shall have the option to receive a final firmware update to the latest version before the project is paid in full.
10. Contractor shall coordinate with the owner for IP addressing, network configuration, and multicast network configuration.
11. All cameras, regardless of manufacturer/model, shall have a consistent username and non-standard password set. This shall be documented and provided to the owner and consultant prior to inspections.
12. Cameras and devices shall not be manufactured by or contain components manufactured by a federal, state, or local government-proposed blacklisted or sanctioned manufacturer or a subsidiary of those manufacturers.
13. Cameras and devices shall not be an OEM or “white label” product. The camera or device shall be manufactured by the named manufacturer.
14. The cameras and devices firmware shall be developed and manufactured by the stated manufacturer and shall not be developed, written, or OEM by a 3rd party.
15. The camera requirements below represent general performance criteria. Approved equals will have slight differences in specifications. The Owner and Consultant have complete discretion to reject approved equals that stray too far from the minimum requirements.

B. Camera Type 1 (X-Core Indoor Dome)

1. Powered by WN7, Indoor Network AI IR Dome Camera, 4MP resolution @ 30FPS, 4.4~9.3mm(2.1x) (112.1°~47.5°) motorized varifocal lens, Triple codec (H.265/H.264/MJPEG), IR viewable length 40m (131.2ft), USB port for easy installation, Day & Night (ICR), extreme WDR (120dB), DIS with a built-in Gyro sensor, Handover, Hard-coated dome bubble, Analytics events based on AI engine: Object detection(Person/Face/Vehicle/License plate), IVA (Virtual line/Area, Enter/Exit, Loitering, direction, intrusion), Analytics events: Defocus detection, Motion detection, Tampering, Fog detection, Audio detection, Sound classification, Shock detection, Appear/Disappear, IP52, IK08, Operating temperature: -10 °C ~ 50 °C(14°F ~ +122°F), Power: PoE/12VDC, Metal shielded RJ-45
2. Be designed to provide at least two video streams in all resolutions at a selectable range up to 30 frames per second (60Hz mode) using H.265, H.264, and MJPEG.
3. Interior dome camera with IP52 and IK08 ratings.
4. Native resolution of 1920x1080 pixels.

5. Integrated video analytics with object detection and classification for person and vehicle, including car, bus, truck, motorcycle, bicycle, and license plate (not LPR).
6. Integrated audio analytics with scream, gunshot, explosion, and glass break classification.
7. Integrated business intelligence analytics with people counting, queue management, and heat mapping.
8. The minimum horizontal view angle of 119.5°-27.9°.
9. Supports hallway/corridor view mode (90°/270°).
10. Mechanical day/night IR cut filter with integrated IR up to 130'.
11. Integrated varifocal lens, automated iris functionality, and remote focus functionality.
12. Be equipped with true multi-frame wide dynamic range (WDR).
13. The camera shall be capable of smart codecs on the H.265 and H.264 streams, including dynamic GoV and Dynamic FPS.
14. Input power: PoE up to 12.95W and 12 VDC.
15. Manufacturer:

    a. Hanwha XND-C7083RV or replacement product

C. Camera Type 2 (X-Plus PTRZ Outdoor Dome)

1. Powered by WN7, X-Plus series, Outdoor Network AI IR Vandal Dome Camera, 4K resolution @ 30FPS, 4.4~9.3mm(2.1x) (112.1°~47.5°) motorized varifocal lens, Remote lens adjustment (PTRZ), Triple codec (H.265/H.264/MJPEG), IR viewable length 20m (66ft), USB port for easy installation, USB port for easy installation, Day & Night (ICR), extremeWDR (120dB), DIS with a built-in Gyro sensor, Handover, Hard-coated dome bubble, Analytics events based on AI engine: Object detection(Person/Face/Vehicle/License plate), IVA (Virtual line/Area, Enter/Exit, Loitering, direction, intrusion), Analytics events: Defocus detection, Motion detection, Tampering, Fog detection, Audio detection, Sound classification (with NW I/O box), Shock detection, Appear/Disappear, FIPS 140-2, 2x micro SD card (512GB x2), P66, IP67, IP6K9K, NEMA4X, IK10+, Operating temperature: -50°C~+55°C(-58°F ~ +131°F), Power: PoE+/12VDC, Metal shielded RJ-45.
2. Be designed to provide at least two video streams in all resolutions at a selectable range up to 30 frames per second (60Hz mode) using H.265, H.264, and MJPEG.
3. Exterior dome camera with IP66/IP67, NEMA4X, and IK10 ratings.
4. Native resolution of 1920x1080 pixels.
5. Integrated video analytics with object detection and classification for person and vehicle, including car, bus, truck, motorcycle, bicycle, and license plate (not LPR).
6. Integrated audio analytics with scream, gunshot, explosion, and glass break classification.
7. Integrated business intelligence analytics with people counting, queue management, and heat mapping.
8. Minimum horizontal view angle of 119.5°-27.9°.
9. Supports hallway/corridor view mode (90°/270°).
10. Mechanical day/night IR cut filter with integrated IR up to 130'.
11. Integrated varifocal lens, automated iris functionality, and remote focus functionality.
12. Be equipped with true multi-frame wide dynamic range (WDR).
13. Camera shall be capable of smart codecs on the H.265 and H.264 streams, including dynamic GoV and Dynamic FPS.
14. Input power: PoE up to 12.95W and 12 VDC.
15. Manufacturer:

a. Hanwha XNV-9083RZ or replacement product

D. Camera Type 3 (DUO)

1. Network vandal outdoor 2CH AI IR dome camera, (6MP X 2 sensors) 12MP @ 15fps, 3.4~6.8mm(2x) (95.08°~47.64°) motorized varifocal lens, Triple codec (H.265/H.264/MJPEG), IR viewable length 25m (82ft), USB port for easy installation, Day & Night (ICR), extremeWDR (120dB), DIS, Handover, Analytics events based on AI engine: Object detection(Person/Face/Vehicle/License plate), IVA (Virtual line/Area, Enter/Exit, Loitering, direction, intrusion), Analytics events: Defocus detection, Motion detection, Tampering, Audio detection, Sound classification, Appear/Disappear, FIPS 140-2, micro SD card 512GB, IP66, NEMA4X, IK10, Operating temperature: -40°C~+55°C(-40°F ~ +131°F), Power: PoE+, Metal shielded RJ-45, Hard-coated dome bubble
2. Be designed to provide at least two video streams in all resolutions at a selectable range up to 30 frames per second (60Hz mode) using H.265, H.264, and MJPEG.
3. Interior/outdoor DUO camera
4. Native resolution of 3840x2160 pixels.
5. Integrated video analytics with object detection and classification for person and vehicle, including car, bus, truck, motorcycle, bicycle, and license plate (not LPR).
6. Integrated audio analytics with scream, gunshot, explosion, and glass break classification.
7. Integrated business intelligence analytics with people counting, queue management, and heatmapping.
8. Minimum horizontal view angle of 112.1°-47.5°.
9. Supports hallway/corridor view mode (90°/270°).
10. Mechanical day/night IR cut filter with integrated IR up to 130’.
11. Integrated varifocal lens, automated iris functionality, and remote focus functionality.
12. Be equipped with true multi-frame wide dynamic range (WDR).
13. Camera shall be capable of smart codecs on the H.265 and H.264 streams, including dynamic GoV and Dynamic FPS.
14. Input power: PoE up to 12.95W and 12 VDC.
15. Manufacturer:

a. Hanwha PNM-C12083RVD

E. Camera Type 4 (EXISTING QUAD)

1. Wisenet P series network vandal outdoor Multi-sensor Multi-Directional dome camera, 5MP x 4ch multi-directional camera, Motorized PTRZ support, Max. 30fps@5MP (H.265, H.264), 4.13~9.4mm (2.3x) motorized varifocal lens, IR viewable length: 30m, H.265, H.264, MJPEG codec, Multi-streaming, Video analytics, WiseStreamII, IP66, IK10, NEMA4X
2. Be designed to provide at least two video streams in all resolutions at a selectable range up to 30 frames per second (60Hz mode) using H.265, H.264, and MJPEG.
3. Exterior/interior quad camera with IP66/IP67, NEMA4X, and IK10 ratings.
4. Native resolution of 3840x2160 pixels.
5. Integrated video analytics with object detection and classification for person and vehicle, including car, bus, truck, motorcycle, bicycle, and license plate (not LPR).
6. Integrated audio analytics with scream, gunshot, explosion, and glass break classification.
7. Integrated business intelligence analytics with people counting, queue management, and heatmapping.

8. Minimum horizontal view angle of 112.1°-47.5°.
9. Supports hallway/corridor view mode (90°/270°).
10. Mechanical day/night IR cut filter with integrated IR up to 130'.
11. Integrated varifocal lens, automated iris functionality, and remote focus functionality.
12. Be equipped with true multi-frame wide dynamic range (WDR).
13. Camera shall be capable of smart codecs on the H.265 and H.264 streams, including dynamic GoV and Dynamic FPS.
14. Input power: PoE up to 12.95W and 12 VDC.
15. Manufacturer:

    a. Hanwha PNM-9085RQZ1

F. Camera Type 4-2 (NEW QUAD)

1. Wisenet P- series network vandal outdoor Multi-sensor Multi-Directional dome camera, 8MP(4k) x 4ch multi-directional camera, Motorized PTRZ support, Max. 20fps@8MP (H.265, H.264), 3.3~5.7mm motorized varifocal lens, IR viewable length: 15m, H.265, H.264, MJPEG codec, Multi-streaming, Video analytics, WiseStreamII, IP66, IK10, NEMA4X
2. Be designed to provide at least two video streams in all resolutions at a selectable range up to 20 frames per second (60Hz mode) using H.265, H.264, and MJPEG.
3. Exterior/interior quad camera with IP66/IP67, NEMA4X, and IK10 ratings.
4. Native resolution of 3840x2160 pixels.
5. Integrated video analytics with object detection and classification for person and vehicle, including car, bus, truck, motorcycle, bicycle, and license plate (not LPR).
6. Integrated audio analytics with scream, gunshot, explosion, and glass break classification.
7. Integrated business intelligence analytics with people counting, queue management, and heatmapping.
8. Minimum horizontal view angle of 112.1°-47.5°.
9. Supports hallway/corridor view mode (90°/270°).
10. Mechanical day/night IR cut filter with integrated IR up to 130'.
11. Integrated varifocal lens, automated iris functionality, and remote focus functionality.
12. Be equipped with true multi-frame wide dynamic range (WDR).
13. Camera shall be capable of smart codecs on the H.265 and H.264 streams, including dynamic GoV and Dynamic FPS.
14. Input power: PoE+: Max 25.5W, Typical 22.0W.
15. Manufacturer:

    a. Hanwha PNM-C32083RQZ

G. Camera Type 5 (4X4K + 2MP)

1. Wisenet P- series network vandal outdoor Multi-sensor Multi-Directional dome camera, 8MP(4k) x 4ch multi-directional camera, Motorized PTRZ support, Max + 2MP Motorized 40x zoom PTRZ with auto tracking. 20fps@8MP (H.265, H.264) (60 FPS for 2MP lens), 3.3~5.7mm motorized varifocal lens, IR viewable length: 20m (200m for 2MP lens), H.265, H.264, MJPEG codec, Multi-streaming, Video analytics, WiseStreamII, IP66, IK10, NEMA4X

2. Be designed to provide at least two video streams in all resolutions at a selectable range up to 20 frames per second (60 FPS for 2MP lens) with AI off and 15 frames per second with AI on (60Hz mode) using H.265, H.264, and MJPEG.
3. Exterior/interior quad camera with IP66/IP67, NEMA4X, and IK10 ratings.
4. Native resolution of 3840x2160 pixels.
5. Integrated video analytics with object detection and classification for person and vehicle, including car, bus, truck, motorcycle, bicycle, and license plate. With auto tracking and zoom capabilities for 2MP lens (not LPR).
6. Integrated audio analytics with scream, gunshot, explosion, and glass break classification.
7. Integrated business intelligence analytics with people counting, queue management, and heatmapping.
8. Horizontal view angle of 109°-56°.
9. Vertical view angle of 55°-31°
10. Supports hallway/corridor view mode (90°/270°).
11. Mechanical day/night IR cut filter with integrated IR up to 130’.
12. Integrated varifocal lens, automated iris functionality, and remote focus functionality.
13. Be equipped with true multi-frame wide dynamic range (WDR).
14. Camera shall be capable of smart codecs on the H.265 and H.264 streams, including dynamic GoV and Dynamic FPS.
15. Input power: PoE+: Max 25.5W, Typical 22.0W.
16. Manufacturer:

    a. Hanwha PNM-C34404RQPZ

H. Camera Type 6 (Fisheye)

1. Be designed to provide at least two video streams in all resolutions at a selectable range up to 30 frames per second (60Hz mode) using H.265, H.264, and MJPEG.
2. Interior Fisheye camera with IP52 and IK10 ratings.
3. Native resolution of 3840x2160 pixels.
4. Integrated video analytics with object detection, classification, and attributes for a person (gender, upper and lower clothing color, bag, age, mast and glasses, and vehicle including car, bus, truck, motorcycle, bicycle, vehicle color, and license plate (not LPR).
5. Integrated audio analytics with scream, gunshot, explosion, and glass break classification.
6. Integrated business intelligence analytics with people counting, queue management, and heatmapping.
7. Minimum horizontal view angle of 101.4°-45.5°.
8. Supports hallway/corridor view mode (90°/270°).
9. Mechanical day/night IR cut filter with integrated IR up to 100’.
10. Integrated varifocal lens, automated iris functionality, and remote focus functionality.
11. Be equipped with true multi-frame wide dynamic range (WDR).
12. Camera shall be capable of smart codecs on the H.265 and H.264 streams, including dynamic GoV and Dynamic FPS.
13. Input power: PoE+ up to 20.00W and 12 VDC.
14. Manufacturer:

    a. Hanwha XNF-9013RV

2.4 CAMERA MANAGEMENT TOOLS

A. Contractor shall set up on an appropriate server the manufacturer's camera management tools utilized to manage the settings, firmware, and status of all installed cameras. Contractor shall train the Owner on the use of this software.

2.5 CAMERA ANALYTICS PLUG-IN

A. Contractor shall install and configure any analytic plug-ins required on the servers and client workstations as required.

B. Contractor shall furnish and install all licensing required to utilize the analytics and plug-ins.

2.6 PTZ CAMERA ETHERNET AND LOW VOLTAGE POWER SURGE PROTECTOR

A. Contractor shall provide and install a surge protector for all exterior-mounted cameras. Cameras that are not attached to the building or reach above the building roof line shall have a surge protector at the camera side and interior termination side.

B. The re shall be a minimum of a 36" shielded patch cable from the surge protector to the device to allow for adequate clamping time.

C. When the protector is mounted in an interior, dry, or weather-sealed enclosure:

1. Shielded RJ-45 jacks and ground

    a. Connect ground directly to ground bar (TMGB/TGB) or ground.
    b. Do not use shielded cable on the output.

2. Connections for 12/24V AC/DC power.
3. Maximum supported data rate: 1,000Mb/s (1 Gigabit)
4. Supports IEEE 802.3af, 802.3at (PoE), and PoE+ up to 144 watts per port.
5. Max current rating of 20,000A per pair on data connections.
6. Max current rating of 2,000A per pair on power connections.
7. UL 497B listed
8. RG-45 in and RJ-45 out.
9. Manufacturer:

    a. Ditek DTK-PVPIPS

2.7 SURGE PROTECTION FOR LOW-VOLTAGE AC/DC POWER

A. Contractor shall provide a surge protector for all exterior devices being supplied by low voltage power. This does not include devices directly connected to a building where the risks of surges are negligible.

B. There shall be a minimum of a 36” shielded cable from the surge protector to the device to allow for adequate clamping time.

C. When the protector is mounted in an interior, dry, or weather-sealed enclosure:

1. Nominal voltage rating of 24V AC/DC. Provide the correct module per the required voltage level if different from 24V.
2. 20,000A surge current rating.
3. Protects 2-pair per module.
4. Accepts up to 10AWG cable
5. Connect directly to ground.
6. UL 497B listed
7. Provide quantity of modules as required for the application.
8. Provide base mounting plate as required for the application.
9. Manufacturer:

a. Ditek DTK-2MB Mounting Base
b. Ditek DTK-2MHLP24B Surge Module
c.

2.8 VOLTAGE REGULATOR

A. Contractor shall provide voltage regulators to convert from 24 VAC power to 12 VDC power where required.

B. Input: 24 VAC or 24 VDC

C. Output: 12VDC up to 3A continuous load.

D. Manufacturer:

1. Altronix VR5T

PART 3 - EXECUTION

3.1 INTEGRATION WITH PHYSICAL SECURITY SYSTEMS AND INTERCOM/PA SYSTEM

A. The video surveillance system shall be integrated with the Physical Security Systems and Intercom/PA system via an Ethernet interface with the following minimum features.

1. Graphical floor plan maps showing icons of all cameras, intercoms, and other integrated systems.
2. Camera views associated with intercom stations and doors.
3. Camera views are linked to other camera views for seamless tracking of a subject throughout a facility.
4. Device names brought in from the integrated systems.
5. Database entries for all actions performed.

6. Time syncing via common NTP server.
7. Microsoft Active Directory integration.
8. Microsoft Exchange integration for email notifications.
9. Intercom audio recorded to the VMS server synchronized with the associated camera.

B. Contractor shall provide any and all licensing to integrate the systems together, including any additional items to be added to the yearly maintenance agreement.

C. Refer to the individual specification sections for additional specific integration requirements.

D. Contractor shall set up a meeting between the Owner, Consultant, and manufacturer to determine the exact functionality of the integration before the integration starts.

3.2 SYSTEM PROGRAMMING

A. Contractor shall provide all programming necessary for a turnkey system.

B. Programming shall include setting all required IP addressing, setting passwords, firmware upgrades, adding the devices into the software, setting video streams, motion detection areas, recording settings, device naming, mapping, cross-system integration, etc.

3.3 SYSTEM PARTITIONING, ZONING, AND NAMING

A. Contractor shall program each facility to be in its own partition. Some facilities may require sub-partitions to control user access to certain areas. Each manufacturer may use different names for partitions, zones, areas, etc. Adapt as required.

B. All devices, inputs, outputs, and other applicable software/hardware entities shall be named by Contractor.

C. As a basis to start, the following partition, zoning, and naming shall be followed:

1. Partition: Building name

    a. Zone 1: Building name and zone name such as exterior, 1st floor, etc.

        1) Device 1: Building name and floor number– Camera or other device name
        2) Device 2: Building name and floor - Camera or other device name
        3) Repeat as required

    b. Zone 2: Building name and zone name such as 2nd floor, etc.

        1) Device 1: Building name and floor - Camera or other device name
        2) Device 2: Building name and floor - Camera or other device name
        3) Repeat as required

    c. Repeat zones as required.

2. Repeat Partitions as required.

D. Camera Naming

1. All cameras shall be named based on the Owner's direction.
2. Multi-sensor cameras shall be named similarly, and each sensor shall end with an identifier such as A, B, C, and D so the images can be easily aligned in the client software by an end user.

E. The Owner shall have the final say. Contractor shall schedule a coordination meeting with the Owner and Consultant to coordinate the actual project structure and naming prior to starting any programming.

3.4 VMS VIDEO STREAMING

A. All cameras shall have the following VBR streams configured. If a camera or VMS is not capable of the quantity of streams listed below, then they shall be set for dual streaming at the Record settings and Live viewing settings.

B. The VMS and cameras shall be set up and enabled for multicast.

1. Stream 1 (Record and High Resolution)

a. Interior Cameras:

1) 10 fps
2) 1 keyframe (I-Frame) per 4 seconds
3) Max resolution
4) 100% recording with motion enabled for metadata.
5) VBR with no cap or high cap when smart codecs are enabled.
6) H.264 Main Profile compression
7) Smart codec enabled at the following settings:
8) Medium (50%) dynamic compression setting
9) Dynamic GoP of up to 30 seconds
10) Dynamic frame rate enabled
11) AAC Audio encoding (for cameras with microphones connected or built into the m).

b. Exterior Cameras:

1) 10 fps
2) 1 keyframe (I-Frame) per 4 seconds
3) Max resolution
4) 100% recording with motion enabled for metadata.
5) VBR with no cap or high cap when smart codecs are enabled.
6) H.264 Main Profile compression
7) Smart codec enabled at the following settings:
8) Medium (50%) dynamic compression setting
9) Dynamic GoP of up to 30 seconds
10) Dynamic frame rate disabled

2. Stream 2 (Live)

    a. 10 frames per second
    b. ~850x450 resolution for 16:9 aspect ratio cameras and 640x480 for 4:3 aspect ratio cameras. Always maintain the native aspect ratio of the camera.
    c. H.264 Main Profile compression
    d. Smart codec enabled at a medium setting with a dynamic GoP of up to 8 seconds.
    e. 1 keyframe per 4 seconds
    f. Automatic stream selection with dynamic resolution (resolution of camera window on VMS client)

3. Stream 3 (Low Resolution)

    a. 10 frames per second
    b. ~1280x720 resolution for 16:9 aspect ratio cameras and 1024x768 for 4:3 aspect ratio cameras. Always maintain the native aspect ratio of the camera.
    c. H.264 Main Profile compression
    d. Smart codec enabled at a medium setting with a dynamic GoP of up to 8 seconds.
    e. 1 keyframe per 4 seconds
    f. Automatic stream selection with dynamic resolution (resolution of camera window on VMS client)

4. Stream 4 (Web/Remote/Mobile Client)

    a. 5 frames per second
    b. MJPEG at 50% quality when VMS requires for web or mobile clients to avoid transcoding from H.264.
    c. ~850x450 resolution for 16:9 aspect ratio cameras and 640x480 for 4:3 aspect ratio cameras. Always maintain the native aspect ratio of the camera.
    d. Data rate cap or as appropriate based on available bandwidth and use case.
    e. Automatic stream selection with dynamic resolution (resolution of camera window on VMS client)

3.5 CAMERA POSITIONING PROCEDURES

A. Contractor shall provide an initial aim, zoom, field of view adjustment, rotation, and focus immediately after the camera is installed, following the design intent on the drawings and camera schedule.

B. Contractor shall then take screenshots from the camera’s web interface, label them based on the drawings device number and present them to the Owner and Consultant for an initial review and comment. Contractor shall furnish a battery-powered PoE injector to power up the camera to provide the initial aim/focus and screenshots and shall not rely on the Owner’s network or PoE switches to be online or available.

C. Contractor shall then fine tune the camera’s aim, and field of view based on the Consultant’s feedback and update the screenshots.

D. After the camera's aim, zoom, field of view adjustment, and focus are finalized by the Consultant, Contractor shall submit the screenshots to the Owner to obtain their final sign-off or comments. If any comments are received, Contractor shall make the adjustments necessary and take updated screenshots and submit for re-approval.

E. The above will not happen at the same time, and Contractor shall plan on multiple trips to the project to make the adjustments.

F. Contractor shall include the final screenshots as part of the as-builts.

3.6 PASSWORDS

A. Contractor shall coordinate a secure project password with the Owner and Consultant. This password shall be documented by Contractor and used for all devices.

B. This secure password shall be set in the archiver default password field, and each device in the video unit tab shall be set to use that set default.

3.7 ARCHIVE TRANSFER (VIDEO TRICKLING) REQUIREMENTS

A. All wireless connected cameras shall be set to record to local SD storage upon loss of wireless connectivity.

B. Contractor shall set up and configure archive transfer (video trickling) on both the camera and server. Upon loss and restoration of connectivity, the camera shall trickle the video back to the archiver, so there is no loss in recorded video.

C. Each camera shall have its own individual archive transfer configured with a 30 second delay on transfer after reconnection.

D. Follow manufacturers best practices guide for configuration.

3.8 TESTING

A. Refer to Section 270000 for additional requirements.

B. Prior to energizing or testing the system, ensure the following:

1. All products are installed in a proper and safe manner per the manufacturer's instructions.
2. Dust, debris, solder, splatter, etc., is removed.
3. Cable is dressed, routed, and labeled; connections are consistent with regard to polarity.
4. All products are neat, clean, and unmarred, and parts are securely attached.

C. Contractor shall ensure that each device in the security system is functioning normally and in such a manner as to meet the functional and performance requirements in this specification.

3.9 TRAINING

A. Refer to Section 270000 for additional requirements.

B. Provide system operations, administration, and maintenance training by factory-trained personnel qualified to instruct.

1. Contractor shall provide up to 12 hours of scheduled and dedicated training time in three (3) four (4) hour sessions for administration and investigation.
2. Contractor shall provide up to 2 hours of scheduled and dedicated training time for maintenance, including lens and dome cleaning, focusing, and positioning.
3. Provide printed training materials for each trainee, including product manuals, course outline, workbook or student guides, and written examinations for certification.
4. Provide hands-on training with operational equipment.
5. Training shall be oriented to the specific system being installed under this contract as designed and specified.
6. Contractor shall provide all necessary documentation of system operating parameters prior to scheduled training sessions.

3.10 WARRANTY

A. Refer to Section 270000 for additional requirements.

3.11 INSTALLATION PRACTICES

A. All services provided shall be professional and conform to the highest standards for industry practices. The Owner reserves the right to halt any installation due to poor workmanship. All work shall be defect free, and the installer shall replace, at their expense, any work found to be defective.

B. The Owner reserves the right to halt any installation due to failure of Contractor to observe installation-free periods due to instructional or administrative requirements. To the maximum extent possible, the Owner will provide advance notice of such periods.

C. Contractor is responsible for providing a complete and functional video surveillance system.

D. All manufactured items, materials, and equipment shall be applied, installed, connected, erected, used, and adjusted as recommended by the manufacturers or as indicated in their published literature unless specifically noted herein to the contrary.

E. Contractor shall follow these standards and approved submittals for locations of power supplies. The Owner intends to limit the number and location of power supplies to facilitate more effective long-term support and maintenance of the system.

3.12 COORDINATION

A. Contractor shall provide up to 8 hours (up to four, 2-hour sessions) of scheduled and dedicated coordination time to assist Owner with camera positioning/repositioning and coordination as requested by Owner or Consultant, including post final signoff.

3.13 AESTHETICS

A. All cables and equipment terminating at panels frames shall be vertically straight, with no cables crossing each other, from twelve inches inside the ceiling area to the termination block.

B. All cable bundles shall be combed and bundled to accommodate individual termination block rows and panels.

C. For any given telecom room, a horizontal and vertical alignment for all mounting hardware will be maintained to provide a symmetrical and uniform appearance to the distribution frame.

D. All surface-mounted devices shall be firmly secured level and plumb

E. All rack mount equipment shall be securely installed.

3.14 HARDWARE LAYOUT

A. Hardware positioning and layout shall be reviewed and approved by the Owner prior to construction. The review does not exempt Contractor from meeting any of the requirements stated in this document.

3.15 VMS INSTALLATION PRACTICES

A. Verify that the manufacturer approved server hardware OS meets the Owner’s IT standards prior to ordering.

B. Coordinate server power, cooling, and mounting requirements with Owner prior to installation.

C. Coordinate virus scan/security software requirements with Owner and manufacturer prior to installation.

3.16 DEVICE CABLING/WIRING INSTALLATION PRACTICES

A. All external wires and cables shall be supported at least every five feet from the structure or as required to maintain not more than 12" cable sag between supports and without over tensioning the cables. Provide j-hooks as needed where cable tray or raceway is not available.

B. Contractor shall coordinate installation with Division 270500 cabling to ensure there is at least 2-inches of physical separation between security cabling and voice/data cabling throughout cable path. Voice/data cabling has first claim to cable tray.

C. All cables, regardless of length, shall be labeled within 18" of both ends with an identifier that is keyed to the door, room, or corridor number as identified.

D. All cables shall have 6-foot service loops neatly coiled in the equipment room. During initial cable rough-in, Contractor shall have sufficient slack to route anywhere within the equipment room.

E. Cabling shall be adequately supported with Velcro wire wraps and horizontal support cable managers fastened to rack frame. Cables shall be dressed in a neat and orderly fashion. Any cabling or equipment installation that is deemed unacceptable by the Owner or Consultant shall be replaced or corrected by Contractor at no additional cost. Plastic zip ties are not allowed.

F. All cables are to run at right angles to the structure, placed above the ceiling in halls or corridors.

G. Cables shall not run above red iron joist.

H. Contractor shall make every effort to conceal wiring and other apparatus into walls, floors, and ceilings, assuming code and good engineering practice allows and suggests.

I. Ties and straps shall be installed snugly without deforming cable insulation. Ties shall be spaced at uneven intervals, not to exceed four feet. No sharp burrs shall remain where excess length of the cable tie has been cut.

J. Contractor shall notify Owner immediately if obstruction or hazard is discovered in a pathway provided by others.

K. Cable shall be stored and handled to ensure that it is not stretched, kinked, crushed, or abraded in any way. Bend radiuses shall meet manufacturer specifications and/or recommendations. Cable shall not be installed in ambient temperatures or moisture conditions above or below the manufacturer’s rating.

L. No splices shall be installed in any cable.

3.17 CABLE TERMINATION

A. Termination hardware (blocks and patch panels) positioning and layout shall be reviewed and approved by the Owner prior to construction. The review does not exempt Contractor from meeting any of the requirements stated in this document.

3.18 ELEVATOR INTERFACE

A. Contractor shall furnish and install an elevator interface box outside of the elevator equipment room when cameras are located within the elevator cab.

1. Contractor shall provide an elevator security junction box located outside of the Elevator Machine Room for interface of security devices to be located within the elevator cab(s). This requirement complies with ANSI A17.1 code which prevents work within the Elevator Machine Room other than specific elevator work.

2. Security J-box shall include a keyed lockable door. Additionally, security J-box shall have proper terminal strips suitable for terminating all cables and mounting electronics within the J-box.
3. The Electrical Contractor shall provide 120VAC power to this enclosure as required to power the electronics.
4. Contractor shall provide any data cables to this enclosure as required.
5. Electronics for access control may be placed within this enclosure.
6. Coordinate exact location of elevator security junction box with the Elevator Contractor, Architect, and Consultant, prior to installation.
7. Provide all cabling as required between the security system and elevator security J-box for all elevator interfaces.
8. Provide all required interface points for connecting to elevator travel cables.
9. Cables entering the elevator security J-box and elevator equipment room shall be appropriately labeled by Contractor so that the Elevator Contractor can connect the appropriate wires to travel cables. Wires should be individually labeled to separate them from other elevator functions and to assist the Elevator Contractor in making proper connection points.
10. Contractor shall coordinate with the Elevator Contractor to ensure the appropriate cable is located within the elevator travel cable.

3.19 FIRE STOPPING

A. Fire stopping of openings between floors, fire-rated walls, and smoke-rated walls created by others for Contractor to pass cable through shall be the responsibility of Contractor. Sealing material and application of this material shall be accomplished in such a manner that is acceptable to the local fire and building authorities having jurisdiction over this work.

B. Any openings created by or for Contractor and left unused shall be sealed up by Contractor.

C. Contractor shall be responsible for creating a waterproof seal in and around any openings that Contractor creates from the structure to the outside environment.

3.20 SYSTEM INSPECTION

A. Contractor shall coordinate with project representative for inspection after Contractor has completed testing of entire system.

B. Contractor shall have trained Contractor representative and testing equipment on site during inspection to assist with spot verification of tests.

C. The Contactor shall verify with Project Representative the precise positioning of camera aim and shall make fine adjustments as requested.

3.21 LABELING

A. Contractor shall neatly label all security devices and cabling at both ends. All labels shall be on Project as-built drawings.

3.22 CAMERA INSTALLATION

A. Contractor shall field verify all camera locations and positioning with Owner prior to installation.

3.23 DOCUMENTATION

A. Upon completion of the installation, Contractor shall provide full documentation sets to the Consultant for approval as described in section 276000. All documentation shall become the property of the Owner.

B. Documentation shall include the additional specific items detailed in the subsections below:

1. Contractor shall provide hard copy and electronic forms of the final test results.
2. Contractor shall provide a document including the following:

    a. Camera label/identifier
    b. Location of each drop by orientation/permanent landmark in the room
    c. Contractor shall provide accurate as-built Construction Drawings. The drawings are to include cable routes and device locations.

3.24 PRE-CHECKOUT

A. Contractor shall demonstrate the following to Owner during system demonstration.

1. The cameras are fully installed and functional.
2. Camera adjustments are complete to the Owner’s satisfaction, including:

    a. Aim/Zoom
    b. Focus/Back Focus
    c. Masking Zones
    d. Motion Detection Zones
    e. Pre-Sets/Tours

3.25 FINAL ACCEPTANCE

A. In addition to closeout requirements in section 276000, Contractor shall demonstrate the following before final approval.

1. Owner training is complete.
2. Punch list items are complete.
3. As-built documentation is complete and submitted to Owner/Consultant.

3.26 FINAL PROCEDURES

A. Perform final procedures in accordance with section 276000.

END OF SECTION 276400

SECTION 276600 - INTRUSION DETECTION SYSTEM

PART 1 - GENERAL

1.1 SCOPE

A. Contractor shall furnish and install intrusion cabling and detection hardware devices, mounting brackets, power supplies, switches, controls, consoles, and other components of the system as shown and specified. Some devices and/or input/output modules may be owner provided and will require connecting into the existing intrusion data lines.

B. Contractor shall furnish and install intrusion detection hardware devices, mounting brackets, power supplies, switches, controls, consoles, and other components of the system as shown and specified.

C. Provide necessary materials, hardware, software, and cabling required to furnish a fully functional system as shown and specified.

D. Provide all required programming, testing, and commissioning for a complete turn-key system.

E. Furnish and install outlets, junction boxes, conduit, connectors, wiring, and other accessories necessary to complete the system installation. Requirements shall be in accordance with Division 26 00 00, Electrical.

F. Contractor shall:

1. Furnish and install a new and complete, low-voltage Intrusion Detection System (IDS) by Bosch Security.
2. Contractor shall furnish and install intrusion detection hardware devices, mounting brackets, power supplies, switches, controls, consoles, and other components of the system as shown and specified.
3. Provide necessary materials, hardware, software, and cabling required to furnish a fully functional system as shown and specified.
4. Provide all required programming, testing, and commissioning for a complete turn-key system.
5. Furnish and install outlets, junction boxes, conduit, connectors, wiring, and other accessories necessary to complete the system installation. Requirements shall be in accordance with Division 26 00 00, Electrical.
6. The project will have the main panel at the building MDF. From there, individual POPIT loops will be run to each area of the building. Zone expanders can be installed in IDFs as needed for distance purposes. Arming and disarming keypads shall be located in the main office and kitchen. The system will have two partitions. The system will be integrated with OpenOptions, and it will be the program to send contact id via a network card. Please make sure to have two network cards in the system, one for transmitting signals and another for integration. Long-range and short-range motions will be used. No 360 motions.

G. Refer to Section 270000 for additional project scope information.

H. Existing systems/devices being demolished to be returned to owner for first right of refusal.

1.2 RELATED WORK

A. Section 270000 – General Technology Requirements

B. Section 270500 – Communications General Requirements

C. Section 270526 – Grounding and Bonding for Technology Systems

D. Section 270528 – Pathways for Technology Systems

E. Section 270537 – Firestopping for Technology Systems

F. Section 271100 – Communications Equipment Rooms

G. Section 271500 – Communications Horizontal Cabling

H. Section 271600 – Communications Connecting Cords

I. Section 271800 – Communications Labeling and Identification

J. Section 275100 – Distributed Communications Systems

K. Section 276000 – Physical Security General Requirements

L. Section 276200 – Electronic Access Control System

M. Section 276400 – Video Surveillance System

1.3 DEFINITIONS

A. Refer to Section 270000 for additional definitions.

1.4 REFERENCE STANDARDS AND CODES

A. National Electric Code, Article 760.

B. National Fire Alarm Code (NFPA 72).

C. Administrative Council for Terminal Attachments (ACTA):

1. ANSI/TIA-968-A-2002 Technical Requirements for Connection of Terminal Equipment to the Telephone Network.

D. American National Standards Institute (ANSI):

1. ANSI C63.4 Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.

E. Federal Communications Commission (FCC):

1. Title 47 C.F.R. Part 15; Class B – Radiated and Conducted Emissions.
2. Title 47 C.F.R. Part 68; rules governing the connection of Terminal Equipment (TE) to the Public Switched Telephone Network (PSTN).

F. The National Institute of Standards and Technology of the United States of America (NIST):

1. Federal Information Processing Standards Publications 197 (FIPS 197) –Advanced Encryption Standard (AES).

G. 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 985 - Household Fire Warning System Units.
6. UL 1023 - Household Burglar Alarm System Units.
7. UL 1076 – Proprietary Burglar Alarm Units and Systems
8. UL 1610 - Central Station Burglar-Alarm Units.
9. UL 60950-1 - Information Technology Equipment - Safety.
10. UL 636 – Hold up alarms

H. Refer to Section 270000 for additional requirements.

1.5 QUALIFICATIONS

A. Contractor shall be a Bosch Expert or Master certified dealer.

B. Refer to Section 270000 for additional requirements.

1.6 PRE-CONSTRUCTION SUBMITTALS

A. Contractor shall submit the intrusion detection hardware layouts, which include the number of controllers, sub-panels, and other associated devices per location.

B. Contractor shall submit full power calculations, which include the anticipated power loads, number, and type of power supplies, including all power supply boards, number of 120VAC circuits required, battery backup, including the quantities of batteries to meet requirements.

C. Refer to Section 270000 for additional requirements.

1.7 PRE-INSTALLATION PROCEDURES

A. For in-use, existing facilities or retrofit projects, Contractor shall assign all applicable electronics IP addresses, passwords, and pre-build out all the enclosures, including the interconnects within the enclosure, prior to being delivered to the project or installed.

B. Contractor shall cable all monitored doors, detectors, etc., and terminate this cable in the control panels no less than 3 weeks prior to substantial completion, regardless of the status of the field devices.

C. Contractor shall program the intrusion detection system no less than 2 weeks prior to substantial completion so when field devices are installed and terminated, the full system functionality can be tested. Programming shall include all monitored doors, associated inputs, outputs, and interoperability regardless of final field device status.

D. Contractor shall perform final connections and testing onsite when field devices have been installed.

E. Refer to section 270000 for additional requirements.

1.8 CONSTRUCTION PROGRESS SUBMITTALS

A. Refer to Section 270000 for additional requirements.

1.9 CLOSEOUT SUBMITTALS

A. Refer to Section 270000 for additional requirements.

PART 2 - PRODUCTS

2.1 SUBSTITUTIONS

A. Unless noted otherwise, products in this section are intended as a basis of design and are open to substitutions per the product substitution procedures defined in Section 270000.

2.2 ALARM CONTROL PANEL

A. Shall be fully programmable multi-zone zone UL listed, Commercial intrusion alarm panel. Minimum features include:

1. 599 programmable points with up to 63-point profiles
2. 32 areas
3. 32 keypads
4. 504 RF points supporting Radion, Innovonics, and Z-Wave.
5. Supports virtual inputs
6. 2,000 users

7. Ground fault monitoring
8. Programmable for Fire, Intrusion, Access, Gas, and Supervisory devices.
9. Cloud enabled with mobile app and remote programming capabilities.

B. The panel shall include onboard 10/100 full duplex Ethernet connectivity.

1. Provide with secondary 10/100 full duplex ethernet expansion module where required for integration to 3rd party systems or as otherwise required.

C. Supports multiple EoL resistor options:

1. Dual 1 kΩ (1 kΩ + 1 kΩ), basis of design.
2. Single 1 kΩ
3. Single 2 kΩ
4. No EoL

D. Provide with all appropriate modules as required for a complete system.

E. Requires 16.5-18 VAC, provide with appropriate power supply connection as specified within this section. Wall warts are not allowed.

F. UL 365, 609, 636, 1610, 1635, and 1076 listed.

G. Integrated battery charger.

H. Expansion slots for onboard cellular or digital dialer primary or backup communication.

I. The panel shall be hardwired to a dedicated electrical circuit. Wall warts are not acceptable.

J. All controllers and expansion modules shall have the latest recommended firmware installed and shall have matching firmware versions. Contractor shall provide all necessary firmware upgrades to keep the Owner on the latest version throughout the duration of the project. At the completion of the project, the Owner shall have the option to receive a final firmware update the latest version before the project is paid in full.

K. Manufacturer:

1. Bosch B9512G

2.3 PROGRAMMING AND MANAGEMENT SOFTWARE

A. Provide software platform to manage remote programming, account storage, remote control, and diagnostics for compatible control panels.

B. Provides automated reporting and time synchronization.

C. Can create templates for quicker programming of new panels.

D. Provides remote firmware updating capabilities.

E. Can operate as an unattended live server service.

F. Compatible with Windows Server 2012 R2 and Windows 10.

G. Compatible with Microsoft SQL 2012 SP2, 2014, 2016, 2017, and 2019. Utilize SQL 2019 when Owner does not have a central SQL server.

H. Optional user management module add on supports up to 250,000 users and 10,000 control panels to provide centralized user management and historical reporting.

I. The Owner shall be able to receive all major and minor software updates at no additional cost for the duration of the project. At the completion of the project, the Owner shall have the option to receive a final software update to the latest version before the project is paid in full.

J. Manufacturer:

1. Bosch RPS (Remote Programming Software) D5500CU

a. Provide with (5) Bosch D5370-USB Security Dongle

2. Provide with optional Bosch RPS-UMM user management module for up to (100) control panels.

2.4 KEYPADS, TOUCHSCREEN

A. Contractor shall furnish and install (1) touch screen keypad next to or on the door of the main intrusion detection panel enclosure in addition to other locations noted.

B. Color backlit touch screen.

C. UL Listed.

D. Requires 12 VDC @ 400 mA.

E. Onboard inputs and outputs shall not be utilized.

F. Disable the onboard prox reader.

G. Manufacturer:

1. Bosch B942W

2.5 INPUT EXPANSION MODULE

A. Provide input expansion modules for all devices. Controller onboard inputs are reserved for other uses. Inputs from keypads shall not be used.

B. 8 input expansion module.

C. Requires 12 VDC @ 35 mA.

D. Manufacturer:

1. Bosch B208

2.6 OUTPUT EXPANSION MODULE

A. 8 output expansion module.

B. Dry contacts rated up to 24 VDC @ 1A.

C. Requires 12 VDC @ 150 mA.

D. Manufacturer:

1. Bosch B308

2.7 ETHERNET EXPANSION MODULE

A. Provide a dedicated Ethernet expansion module for integration with the access control system.

B. 10/100 full duplex Ethernet expansion module

C. NIST-FIPS197 Certified for 128-bit to 256-bit AES Encrypted Line Security

D. Full web browser interface.

E. Requires 12 VDC @ 100 mA.

F. Manufacturer

1. Bosch B426

2.8 POWER SUPPLY EXPANSION MODULE

A. Contractor shall provide a supervised power supply module for each intrusion panel to provide power to the detectors and batteries.

B. Requires 18VAC input.

C. Provides up to 4A of power at 12VDC.

D. High-capacity battery charging circuit with 150mA output power for charging up to 2 batteries.

E. Supervised.

F. Manufacturer:

1. Bosch B520

2.9 BATTERIES AND BACKUP

A. Contractor shall provide a minimum of (1) 12V, 7ah, sealed Absorbent Glass Mat (AGM) style batteries with F style terminals per power supply and (1) per control panel. Provide additional as required based on calculated power load.

B. Provide adequate battery backup as required by Authority Having Jurisdiction (AHJ) or a minimum of 8-hours.

C. Manufacturer:

1. Interstate Power Patrol FAS1075
2. Power Sonic PS-1270

2.10 END OF LINE SUPERVISION

A. All monitored intrusion detection devices shall include EoL monitoring.

B. Provide a dual 1k + 1k end of line (EoL) pre-built resistor pack. GRI (George Risk Industries, Inc.) 6644 series.

1. Adjust resistance values as required by the manufacturer.

2.11 POPIT EXPANSION MODULE

A. Provides connection up to 100 POPIT input modules.

B. Install at panel location.

C. Provide quantity as required.

D. Manufacturer:

1. Bosch B299

2.12 POPIT INPUT MODULE

A. Provide for each device on bus.

B. Integrated tamper switch

C. 12 VDC operating voltage.

D. Utilize 33 K-ohm EoL resistor.

E. Manufacturer:

1. Bosch D9127T

2.13 DOOR CONTACTS/DOOR POSITION SWITCHES (DC)

A. The Security Contractor shall be responsible for the connection of all door position devices to the intrusion detection system. Door position devices shall be integral to the door hardware whenever possible. Contractor shall refer to the door hardware schedule and coordinate with the door hardware Contractor on locations and requirements.

B. Sealed and potted magnetic reed switch in contact housing.

C. Provide DPDT for applications with multiple security systems (Access Control/Intrusion Detection or PLC) utilizing a single door contact.

D. Door contacts shall be appropriately sized for any established holes within door frames.

E. Parts provided are basis of design. Determination of final part number is the responsibility of Contractor.

F. Provide color that matches door as close as possible.

G. Provide recessed switch whenever possible.

H. Armored whip for surface mount contacts.

I. Provide GRI (George Risk Industries, Inc.) 180 Series for recessed applications.

J. Provide GRI (George Risk Industries, Inc.) 4400 series for surface mount applications.

K. Provide GRI (George Risk Industries, Inc.) MC-180 Series for hollow top channel applications.

L. Provide GRI (George Risk Industries, Inc.) 4532 Series for overhead door applications.

2.14 MOTION DETECTORS

A. The motion detector shall be a multi-technology, IR, and range adaptive radar device.

B. Reduces false alarms by sensing both heat, physical motion, and compensation algorithms.

C. Wide angle: 60’ x 80’ standard coverage, selectable 25’ x 33’ coverage.

D. Long range: 8.5’ x 100’ standard coverage, selectable 3.3’ x 25’ coverage.

E. Active white light suppression

F. Dynamic temperature compensation

G. Draft and insect immunity

H. Sensor data fusion

I. Power requirements: 9-15 VDC

J. Maximum current draw of 26ma at 12VDC.

K. Can be mounted between 7’-10’ with no adjustments.

L. Provide with appropriate mounting hardware, Bosch B328 (wall), B338 (ceiling), or equal.

M. White.

N. Manufacturer:

1. Wide Angle: Bosch ISC-PDL1-W18G
2. Narrow Angle, long range: Bosch ISC-PDL1-WC30G

2.15 PANIC AND DURESS BUTTONS

A. Stainless steel cover

B. DPDT contacts for connecting to multiple systems

C. Fully supervised

D. Reset key for testing and resetting alarms

E. Recessed latching button to prevent accidental activation

F. Coordinate exact mounting location with Owner prior to purchase and installation

G. Manufacturer:

1. Honeywell 269R

2.16 INTRUSION DETECTION PANEL ENCLOSURES

A. Provide a power supply/chargers and sub-assemblies to power various intrusion controller boards, detectors, audible/visual alarms, and other access control or security system components. Contractor shall select the appropriate enclosure, power supply, and sub-assemblies for each application.

B. Enclosures

1. Shall be capable of accommodating power supplies, sub-assemblies, and other manufacturers' boards when required.
2. Wall mountable.

3. Include a cam-lock and tamper switch.
4. Provide with main backplane and door backplane.
5. Provide with power rocker switches between each transformer and the board.
6. Manufacturer:

    a. Altronix Trove2BH2 with TBHD2 door backplane or as appropriate for intrusion panel manufacturer.

C. Sub-Assemblies

1. Contractor shall provide all sub-assemblies to meet the project requirements.
2. Access Control Module

    a. Independently controlled fused protected outputs:

        1) Fail-Safe and/or Fail-Secure power outputs.
        2) Dry form “C” 5 amp rated relay outputs (fused).
        3) Any combination of the above

3. Access Control System trigger inputs:

    a. Normally open (NO) inputs.
    b. Open collector sink inputs.
    c. Any combination of the above.

4. Multi-Output Power Distribution Module

    a. Single input distributed over eight (8) or sixteen (16) outputs.
    b. Fused protected outputs.
    c. Output terminals shall accommodate up to 12AWG wires.

5. Multi-Output Power Distribution Module with Dual Inputs

    a. Two (2) inputs distributed over eight (8) outputs.
    b. Outputs shall be configurable by input.
    c. Fused protected outputs.
    d. Output terminals shall accommodate up to 12AWG wires.

6. Power supplies and sub-assemblies shall be manufactured by Altronix:

    a. Altronix ACMS8 – Dual input, eight (8) output, fused Access Control Module (UL listed Sub-assembly).
    b. Altronix PDS8 - Dual input, eight (8) output, fused power distribution module (UL listed Sub-assembly).
    c. Altronix PD16W – Selectable dual input, sixteen (16) output, fused power distribution module (UL listed Sub-assembly).
    d. Altronix RSB2 – Rocker switches with mounting bracket.

2.17 POWER TRANSFORMERS

A. Contractor shall provide all required transformers and power supplies.

B. The power supplies shall be hardwired. Pluggable “wall wart” transformers are forbidden.

C. Provide with enclosure as required.

D. 115 VAC input.

E. Provide a 16 VAC output @ 6.25A transformer to power the control panel.

F. Provide an 18 VAC output @ 16.7A transformer to power the power supply panel.

G. Connect transformers outputs through rocker switches to control on/off power to the panels for service.

H. Manufacturer:

1. Altronix

a. 16VAC Transformer - T16100C

1) Mount above Altronix Trove 2 enclosure in the included Altronix CAB4 enclosure.

b. 18VAC Transformer - T1618300K

1) Mount within Altronix Trove 2 enclosure on main backplane in the upper left corner square punch.

2.18 SURGE PROTECTION FOR DATA AND POWER BUS

A. Contractor shall provide a surge protector for all data/power bus applications that run underground or through an area with high surge risk.

B. Mount unit outside of the power supply/control panels. Provide with appropriate mounting and enclosures as required.

C. The re shall be a minimum of 36” of cable from the surge protector to the device to allow for adequate clamping time.

D. When protector is mounted in interior, dry, or weather sealed enclosure:

1. Nominal voltage rating of 12V AC/DC. Provide correct module per required voltage level if different from 12V.
2. 20,000A surge current rating.
3. Protects 2-pair per module.
4. Accepts up to 12 AWG cable
5. Connect directly to ground.

6. UL 497B listed
7. Provide quantity of modules as required for the application.
8. Provide base mounting plate as required for the application.
9. Manufacturer:

    a. Ditek DTK-MB10 Mounting Base, upsize as required if multiple modules are required.
    b. Ditek DTK-2MHLP12F Surge Module, (1) per 2-pair
    c. Or approved equal

2.19 CABLES

A. Provide cabling per manufacturer's recommendations and code requirements for riser rated, plenum, and non-plenum cable types.

B. UTP data cabling required will be provided, installed, terminated, and tested by the Division 27 structured cabling Contractor.

C. Door Contacts, Panic/Duress Buttons, mechanical sensors, etc.: 22-gauge, two-conductor, unshielded, stranded cable shall be provided for all door contacts. The cable shall be white in color and plenum rated.

D. Motion Detectors: 22-gauge, four-conductor, shielded, stranded cable shall be provided for all motion detectors. The cable shall be white in color and plenum rated. Provide 18-gauge where distances and voltage drop require it.

E. Keypads/SDI2 Bus: 18-gauge, four-conductor, non-shielded, non-twisted, stranded cable shall be provided for keypads. The cable shall be white in color and plenum rated. Keypad cabling shall not exceed 390 feet. Cable impedance shall not exceed 100 ohms.

F. Wireless Receivers/Repeaters Power Cable: 18-gauge, two-conductor, unshielded, stranded cable shall be provided for all wireless receivers and repeaters. The cable shall be white in color and plenum rated. The cable shall not exceed 328 feet. Increase gauge as required based on voltage drop.

G. POPIT Bus: 18-gauge, four-conductor, non-shielded, twisted (6-twist per foot min), stranded cable shall be provided for the POPIT loop. The cable shall be white in color and plenum rated for interior, and OSP rated when routed underground. Cable impedance shall not exceed 100 ohms. Do not exceed manufacturer recommendations for maximum cable length. Furnish and install a 33-kohm EoL resistor on the last device in the loop.

H. Follow manufacturer's recommendations for all systems cabling.

PART 3 - EXECUTION

3.1 PHYSICAL SECURITY INTEGRATION

A. The intrusion detection system shall be integrated with the electronic access control system.

B. System will integrate with Open option.

1. The access control/intrusion detection interface shall be via an Ethernet interface. Contact closure integration is not acceptable.

C. Contractor shall provide any and all licensing to integrate the systems together, including any additional items to be added to the yearly maintenance agreements.

D. Refer to the Electronic Access Control specifications for additional specific integration requirements.

E. The Intrusion system shall be time syncing to a common NTP server across all security systems.

F. The Intrusion system shall synchronize users enrolled or removed through the access control system.

G. The Intrusion system shall disarm on first in authorized and valid card read. Authorized means the user has the appropriate permissions to disarm the intrusion system.

H. Contractor shall set up a meeting between the Owner, Consultant, and manufacturer to determine the exact functionality of the integration before the integration starts.

3.2 SYSTEM PROGRAMMING

A. Contractor shall set the Ethernet communications to TCP/IP.

B. Contractor shall enable 128-bit AES encryption when required.

C. Contractor shall program all inputs EoL resistance values. All inputs shall have an EoL unless specifically submitted on and approved by the Consultant.

D. Contractor shall configure mail server SMTP settings and port. Contractor shall coordinate with the Owner on email accounts to be added.

E. Programming system configuration parameters (hardware and software, zone/circuit numbers, communication parameters).

F. Programming operational parameters such as opening/closing reports and windows, system response text displays of events, activation of relays that drive auxiliary devices, and identifying types of zones/loops.

G. Programming passcodes according to the authorities and functions defined by the Owner.

H. Contractor shall program all compliance and panel wide parameters, including onboard and add-on module ethernet parameters, Cloud Remote Connect settings, report routing, power supervision, RPS parameters, miscellaneous settings, etc.

I. Contractor shall set all point, point profiles, area, and debounce times according to the requirements, best practices, and Owner requirements. Contractor shall create custom point profiles as required for desired functionality.

J. Contractor shall set all Area necessary parameters, including force arm/bypass, exit delay time, restart time, area type, part on, exit/entry delay warning, area re-arm time, etc.

K. Contractor shall assist with entering users, authority levels, and PINs.

L. Other system programming tasks required by the owner. These additional programming requirements shall be coordinated between the owner and Contractor.

M. Operational Testing: Contractor shall perform thorough operational testing, walk testing, and verify that all system components are fully operational.

N. Hard-copy System Printout: Contractor shall submit a hard-copy system printout of all components tested and certify 100 percent operation indicating all devices/panels/units have passed the test criteria set forth by the manufacturer.

O. Acceptance Test Plan Form: An acceptance test plan form shall be prepared/provided by Contractor prior to the acceptance walk-through.

P. This form shall include separate sections for each device/panel/unit as well as a column indicating the manufacturer's performance allowance/margin, a column indicating the result of the testing performed by the Contractor(pass/fail), and an empty column for recording findings during the walk-through.

3.3 SYSTEM PARTITIONING, ZONING, AND NAMING

A. Contractor shall program each facility to be in its own partition. Some facilities may require sub-partitions to allow arming and disarming of specific areas. Each manufacturer may use different names for partitions, zones, areas, etc. Adapt as required.

B. All devices, inputs, outputs, and other applicable software/hardware entities shall be named by Contractor.

C. As a basis to start, the following partition, zoning, and naming shall be followed:

1. Partition: Building name

a. Zone 1: Building name and zone name such as 1st floor, gym, auditorium, etc.

1) Device 1: Building name and floor number – detector or device name
2) Device 2: Building name and floor - detector or device name
3) Repeat as required

b. Zone 2: Building name and zone name such as 2nd floor, etc.

1) Device 1: Building name and floor - detector or device name
2) Device 2: Building name and floor - detector or device name
3) Repeat as required

c. Repeat zones as required.

2. Repeat Partitions as required.

D. Device Naming

1. All devices shall be named based on Owner direction.

E. The Owner shall have the final say. Contractor shall schedule a coordination meeting with the Owner and Consultant to coordinate actual project structure and naming prior to starting any programming.

3.4 INTRUSION REMOTE SOFTWARE PROGRAMMING

A. Contractor shall configure Bosch RPS to utilize the Owner's existing central SQL server. Coordinate requirements with the Owner prior to setting up.

B. The RPS software shall be set to run as a service on server startup.

C. The latest panel firmware shall be loaded in for centralized updating, and all panels shall be on the same firmware version.

D. Contractor shall create all required Owner RPS users.

E. The software shall be set to auto synchronize the time based on server time that is synchronized to the Owner's NTP server.

F. The software shall be set to synchronize/receive panel data daily.

G. The software shall synchronize current panel events daily.

H. Contractor shall set the panels Cloud ID in RPS to enable future Cloud functionality.

3.5 MONITORING SERVICE AND COMMUNICATIONS INTEGRATION

A. Contractor shall program the intrusion panels to communicate to the Owner's preferred monitoring service, which may be their own internal monitoring or an external service.

B. Contractor shall program all applicable route groups for primary and backup using the appropriate communication formats accepted by the monitoring service. Radionics Modem 4 is preferred when possible. Set AES encryption where required.

3.6 MOTION DETECTOR INSTALLATION REQUIREMENTS

A. Point away from outside traffic. Position 360 detectors farther from walls. Microwave energy passes through non-metallic walls.

B. Point or position away from direct and indirect sunlight.

C. Point or position away from glass or other objects that rapidly change temperatures.

D. Point or position away from moving or rotating objects such as fans.

E. Mount the detector on a solid and vibration free surface.

F. Avoid mounting the detector within 1 ft (minimum) of any fluorescent light fixtures.

G. Long range, narrow angle detectors should be mounted in the center of hallways when possible.

H. Wide angle detectors should be mounted in corners of the areas being covered when possible.

I. Wide angle detectors mounted in spaces smaller than 25’ x 33’ should have the DIP switch set to reduce the coverage from the maximum.

J. Long range, narrow angle detectors mounted in corridors shorten than 3.3’ x 25’ should have the DIP switch set to reduce the coverage from the maximum.

K. Detectors should have the down lens enabled unless specifically noted otherwise.

3.7 END OF LINE SUPERVISION

A. Contractor shall furnish and install end-of-line resistors to provide end-of-line supervision on all intrusion input devices. This shall include but is not limited to door position switches, motion detectors, glass break detectors, duress/panic buttons, and all other inputs being monitored.

B. Contractor shall furnish and install resistors as near to the field device as possible. Supervision resistance values shall be natively compatible with the associated control panel.

1. Bosch Security based installations shall utilize 1K resistors to provide a 1K / 2K ohm resistance values from associated inputs.

3.8 WIRELESS SURVEY

A. Contractor shall perform a wireless survey prior to the purchase, rough-in, cabling, or installation of the wireless devices.

B. The wireless survey shall be used to determine the optimal device placement, which shall be documented and sent to the Consultant for review.

3.9 PASSWORDS

A. Contractor shall coordinate a secure project password with the Owner and Consultant. This password shall be documented by Contractor and used for all devices.

3.10 SYSTEM GROUNDING

A. Contractor shall ground all components of the system to the telecommunications grounding system, and ground fault detection shall be enabled according to UL requirements.

3.11 TESTING

A. Refer to Section 270000 for additional requirements.

3.12 TRAINING

A. Refer to Section 270000 for additional requirements.

3.13 WARRANTY

A. Refer to Section 270000 for additional requirements.

B. Contractor shall guarantee all materials, equipment, etc., for one (1) year from date of substantial completion of work. This guarantee shall include labor, material, and travel time.

C. All Intrusion Alarm systems, materials, and labor shall be under warranty for 1 year from date of final acceptance.

3.14 GENERAL

A. Prerequisites

1. Contractor shall maintain a competent (single point of contact) project supervisor, along with competent technical personnel acceptable to the Owner and Consultant, during the entire installation process. Best efforts shall be made to avoid change of the project supervision during the project without prior written approval from the Owner and/or Consultant.
2. Contractor installing any equipment/devices shall be responsible for providing all interconnecting cables to and/or between same equipment that may be required to make equipment fully operational.

B. Requirements and Responsibilities

1. Contractor shall provide, furnish, deliver, transport, erect, install, configure, and connect completely all of the material and equipment described herein or depicted on project drawings. Contractor shall supply all other incidental material required, such as

interconnecting cables, to make the work complete and to install all systems in a turnkey operating condition.

2. Perform this work in accordance with acknowledged industry and professional standards and practices, existing build conditions, and as specified herein. Provide and install all materials, devices, components, and equipment for complete operational systems.
3. Coordinate all efforts and verify field conditions with those of related trades. In the event of any conflicts, delays, or improper preparatory work by others, notify the Owner or Owner's Consultant: The Owner and Owner's Consultant's decision will be binding.

3.15 INSTALLATION PRACTICES

A. All services provided shall be professional and conform to the highest standards for industry practices. The Owner and Owner's Consultant reserve the right to halt any installation due to poor workmanship. All work shall be defect free, and the installer shall replace, at their expense, any work found to be defective.

B. Contractor shall exercise care during installation - damage to cables or equipment will not be accepted. Contractor shall remove any damaged cabling or equipment and replace with new.

C. Contractor is responsible for providing a complete and functional intrusion alarm system.

D. Contractor shall provide low voltage power and control lines to and from power supplies, remotely controlled equipment, and other devices, even though not explicitly indicated on drawings or listed in equipment tables.

E. All manufactured items, materials, and equipment shall be applied, installed, connected, erected, used, and adjusted as recommended by the manufacturers or as indicated in their published literature unless specifically noted herein to the contrary.

F. Contractor shall follow these standards and approved submittals for locations of power supplies. The Owner intends to limit the number and location of power supplies to facilitate more effective long-term support and maintenance of the system.

G. Contractor shall provide rack shelves or rack mounting ears for any equipment that is not rack mountable. All equipment installed using shelves shall be fastened to the rack shelf.

H. Install plates as required on back boxes where they exist. Provide cut-in back boxes where boxes do not exist.

I. Install surface mounted cable raceway systems that match the surface color and/or the other surface mounted raceways where cables cannot run within fishable walls.

J. Contractor installing any RF devices shall be aware that RF devices may cause interference to equipment and shall take whatever precautions necessary to avoid causing interference.

K. The Owner will provide programming information needed to help Contractor with configuration of system. Contractor shall have the responsibility to program the system, ensure proper communications between controlling points and any monitoring companies, and to adjust any system or device causing false alarm conditions.

L. Consideration shall be given not only to operation efficiency but also to overall aesthetic factors.

3.16 COORDINATION

A. Contractor shall provide up to 4 hours (up to two 2-hour sessions) of scheduled and dedicated coordination time to assist Owner with sequence of operation, zone coordination, rule creation, and coordination as requested by Owner or Consultant.

3.17 TRAINING

A. Provide system operations, administration, and maintenance training by factory-trained personnel qualified to instruct.

1. Contractor shall provide up to 4 hours of scheduled and dedicated training time in two (2) two (2) hour sessions for system use and maintenance.
2. Contractor shall provide up to 1 hour of scheduled and dedicated training time in two (2) thirty (30) minutes sessions for system arming and disarming per site.
3. Provide printed training materials for each trainee, including product manuals, course outline, workbook or student guides, and written examinations for certification.
4. Provide hands-on training with operational equipment.
5. Training shall be oriented to the specific system being installed under this contract as designed and specified.
6. Contractor shall provide all necessary documentation of system operating parameters prior to scheduled training sessions.

3.18 SUPPORT

A. Contractor shall make available technical resources, as deemed necessary by the Owner, for database integration projects.

3.19 AESTHETICS

A. All cables terminating at the panel frames shall be vertically straight, with no cables crossing each other, from twelve inches inside the ceiling area to the termination block.

B. All cable bundles shall be combed and bundled to accommodate individual termination block rows and panels.

C. A horizontal and vertical alignment for all mounting hardware shall be maintained to provide a symmetrical and uniform appearance to the distribution frame.

D. All surface-mounted devices shall be firmly secured and level.

3.20 HARDWARE LAYOUT

A. Hardware positioning and layout shall be according to project drawings.

3.21 DEVICE CABLING/WIRING INSTALLATION PRACTICES

A. Contractor shall coordinate with the Electrical Contractor their requirements for conduits and proper AC power to service all equipment installed by Contractor in locations where power is not available.

B. Contractor shall provide for proper ground system to all equipment.

C. Each cable group that can cause interference to another group shall be separated by sufficient distance so as not to cause signal contamination or interference.

D. All external wire and cables shall be supported at least every five feet from the structure or as required to maintain not more than 12" cable sag between supports and without over tensioning the cables.

E. All cables, regardless of length, shall be marked with indelible color-coded labels within 18" of both ends with an identifier that is keyed to the door, room, or corridor number as identified. Labels shall be directly hot stamped, or factory stamped, closed sleeve method. Adhesive strip labels may only be used if protected by transparent heat-shrink tubing. There shall be no unmarked cables at any place in any part of any system. Marking codes used on cables shall correspond and be shown clearly on as-built drawings.

F. Each cable shall be marked at all cable ends with a standard nomenclature (Device, #, closet letter).

G. All cables shall be separated into like groups, according to signal or power levels, and routed separately to eliminate signal contamination and crosstalk - this includes both inside and outside of equipment racks.

H. All cables shall have 6-foot service loops neatly coiled in accessible ceiling. During initial cable rough-in, Contractor shall have sufficient slack to route anywhere within Telecommunications Room. Coordinate exact panel and power supply mounting locations with Electrical Contractor.

I. Cabling shall be adequately supported with Velcro wire wraps, and horizontal support cable managers fastened to rack frame. Velcro straps shall be installed snugly without deforming cable insulation. Cables shall be dressed in a neat and orderly fashion. Any cabling or equipment installation that is deemed unacceptable by the Owner or Consultant shall be replaced or corrected by Contractor at no additional cost.

J. Cable Ties shall be installed snugly without deforming cable insulation. Ties shall be spaced at uneven intervals, not to exceed four feet. No sharp burrs shall remain where excess length of the cable tie has been cut.

K. All cables are to run at right angles to the structure, placed above the ceiling in halls or corridors.

L. Cables shall not run above red iron joist.

M. Contractor shall make every effort to conceal wiring and other apparatus into walls, floors, and ceilings, assuming code and good engineering practice allows and suggests.

N. Contractor shall notify Owner or Owner's Consultant immediately if obstruction or hazard is discovered in a pathway provided by others.

O. Cable shall be stored and handled to assure that it is not stretched, kinked, crushed, or abraded in any way. Bend radiuses shall meet manufacturer specifications and/or recommendations. Cable shall not be installed in ambient temperatures or moisture conditions above or below the manufacturer's rating.

P. No splices shall be installed in any cable.

Q. No security device cabling shall have an accessible disconnect outside of a secured equipment room or within a backbox.

R. Any exterior exposed will be contained in waterproof conduit with the appropriate waterproof fittings.

S. All cables are to run at right angles to the structure, placed above the ceiling in halls and corridors.

T. Contractor shall make every effort to conceal wiring and other apparatus into walls, floors, and ceilings, assuming any applicable codes and good engineering practice allows and suggests.

U. All cabling systems installed in public areas shall be installed within walls, ceilings, or floors or within surface wiring pathways as dictated by codes and good engineering practices.

V. Contractor shall notify the Owner or Owner's Consultant immediately if obstruction or hazard to cable paths are discovered and seek corrective actions.

W. The cables shall be supported by properly insulated wire support hangers, bridal rings, "D" rings, ladder cable tray, or inner duct as may be necessary to support cables.

X. Contractor shall seal any cable penetrations they may use or make where the penetration is part of a firewall or acoustic barrier.

3.22 EQUIPMENT CABINET WIRE AND CABLE INSTALLATION

A. All power cables, control cables, and high-level cables shall be grouped to one side of the equipment rack, while low level cables grouped to the other side.

B. All equipment rack wiring and cabling shall be neatly laced, and ends dressed with heat shrink tubing, and all cables shall have service loops between the horizontal tie bar and the connection to equipment. Rack cabling shall be adequately supported with tie wraps or Velcro wire wraps and horizontal support bars to rack frame as it enters or exits the front or back of equipment.

C. All equipment, rack wiring and cabling shall be neatly dressed.

D. Rack cabling shall be adequately supported with Velcro wire wraps and horizontal support cable managers fastened to rack frame.

3.23 CONNECTORS/CONNECTIONS

A. Moisture Resistance: All connectors shall be crimped or applied in such a way as to prevent moisture from entering the connector or cable.

B. Preparation: Cables shall be carefully prepared and connectors installed as directed by the manufacturer. Proper stripping devices and crimping tools shall be used.

C. Terminations: Connectors shall be carefully fitted to mating devices on equipment to avoid damage to mating contacts, inserts, or bodies. Specialized terminations shall be made in a neat and secure manner, suited to the service of the wire, and as directed by the manufacturer. In all cases where the manufacturer specifies the terminations, those terminations shall be used.

D. Termination Testing: The strength of the termination shall be tested by manually pulling on the connector and cable. Any terminations that exhibit movement, loose cable, or insecure connections shall be re-terminated.

3.24 SPECIAL TECHNIQUES

A. Waterproofing: Contractor shall be responsible for creating a waterproof seal in and around any openings Contractor creates, or are created by others for use by Contractor, that enter or exist in a structure to the outside environment.

3.25 FIRE STOPPING

A. Fire stopping of openings between floors, fire-rated walls, and smoke-rated walls created by others for the telecommunication Contractor to pass cable through shall be the responsibility of the security Contractor. Sealing material and application of this material shall be accomplished in such a manner that is acceptable to the local fire and building authorities having jurisdiction over this work.

B. Any openings created by or for Contractor, and left unused, shall be sealed up as part of this work by the telecommunication Contractor.

3.26 TEST REQUIREMENTS FOR DEVICE CABLING

A. Contractor shall perform continuity tests to ensure cables are free of shorts within the pairs and shall verify cables for continuity, pair validity and polarity, and conductor position.

3.27 SYSTEM TESTING PROCEDURES

A. Prior to energizing or testing the system, ensure the following:

1. All products are installed in a proper and safe manner per the manufacturer’s instructions.
2. Dust, debris, solder, splatter, etc., is removed.
3. Cable is dressed, routed, and labeled; connections are consistent with regard to polarity.

4. All products are neat, clean, and unmarred, and parts are securely attached.

B. Contractor shall ensure that each device in the security system is functioning normally and in such a manner as to meet the functional and performance requirements in this specification.

3.28 SYSTEM INSPECTION

A. Contractor shall coordinate with Consultant for inspection after the Contractor has completed testing of entire system.

B. Contractor shall have trained Contractor representative and testing equipment on site during inspection to assist with spot verification of tests.

C. Contractor shall demonstrate to Consultant the functionality of the system, including the selection of various display modes and accessing system functions.

D. Contractor shall verify with Consultant the precise positioning of all devices and shall make fine adjustments as requested.

3.29 LABELING

A. Contractor shall neatly label all security devices and cabling at both ends. All labels shall be on project as-built drawings.

B. Contractor shall label both ends of the cable within four (4) inches of the termination with the same label identifier. These will be machine printed Brady (or equivalent) labels.

C. Panels shall have labels showing cable numbers and far end locations for each cable terminated in the cabinet.

3.30 DOCUMENTATION

A. Upon completion of the installation, Contractor shall provide full documentation sets to the Consultant for approval. All documentation shall become the property of the Owner.

B. Documentation shall include the items detailed in the subsections below:

1. Contractor shall provide hard copy and electronic forms of the final test results.
2. Contractor shall provide a document including the following:

    a. Device label/identifier
    b. Location of each device by room or corridor number

C. Contractor shall provide accurate as-built Construction Drawings. The drawings are to include cable routes and device locations.

D. Consultant will provide floor plans in paper and electronic formats (“.dwg,” AutoCAD, and “.dxf”) on which as-built construction information can be added. Contractor shall modify these

documents accordingly to denote as-built information as defined above and then return the documents to the Owner.

3.31 FINAL ACCEPTANCE

A. Contractor shall demonstrate the following before final approval.

1. Owner training is complete.
2. Punch list items are complete.
3. As-built documentation is complete and submitted to Owner/Consultant.

3.32 CLOSEOUT PROCEDURES

A. Closeout Submittals: Contractor shall provide closeout documentation to the Consultant. The Consultant shall receive the closeout submittals no less than 72 hours prior to the scheduled inspection time.

B. Inspection: Contractor shall be present for the inspection by the Consultant. Contractor shall supply all testing equipment needed to verify compliance with the specifications.

C. Punch List: Work or materials found to be incomplete, of unsatisfactory quality, failing to meet written system specifications, and/or unacceptable to the Consultant shall be documented by the Consultant and provided to Contractor to rectify.

D. Re-Inspection: If a re-inspection is necessary, the costs of the Consultant’s additional travel, hours, and expenses may be deducted by the Owner from the contract amount due to Contractor.

E. Punch List Approval: The punch list shall be considered complete only after having been signed by the Owner and Consultant.

3.33 CLEANING

A. Prior to system final turnover to Owner:

1. Remove all dirt and debris from equipment racks and equipment rooms.
2. Clean all equipment filters, vents, and fans.
3. Clean all enclosures and back box interiors thoroughly before installing plates, panels, or covers.

END OF SECTION 276600

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SECTION 280500 - BASIC MATERIALS AND METHODS FOR FIRE ALARM

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all Work herein.

B. The Contract Drawings indicate the extent and general arrangement of the systems. If any departure from the Contract Drawings are deemed necessary by the Contractor, details of such departures and the reasons, therefore, shall be submitted to the Architect for approval as soon as practicable. No such departures shall be made without the prior written approval of the Architect.

1.2 SCOPE OF WORK

A. The Work included under this Contract consists of the furnishing and installation of all equipment and material necessary and required to form the complete and functioning systems in all of its various phases, all as shown on the accompanying Drawings and/or described in these Specifications. The contractor shall review all pertinent drawings, including those of other contracts prior to commencement of Work.

B. This Division requires the furnishing and installing of all items Specified herein, indicated on the Drawings or reasonably inferred as necessary for safe and proper operation; including every article, device or accessory (whether or not specifically called for by item) reasonably necessary to facilitate each system's functioning as indicated by the design and the equipment specified. Elements of the work include, but are not limited to, materials, labor, supervision, transportation, storage, equipment, utilities, all required permits, licenses and inspections. All work performed under this Section shall be in accordance with the Project Manual, Drawings and Specifications and is subject to the terms and conditions of the Contract.

C. The approximate locations of Electrical items are indicated on the Drawings. These Drawings are not intended to give complete and accurate details in regard to location of outlets, apparatus, 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 Engineer, who reserves the right to make any reasonable changes in the locations indicated without additional cost to the Owner.

D. 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.

E. All discrepancies within the Contract Documents discrepancies between the Contract Documents and actual job-site conditions shall be reported to the Owner or Engineer 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 more costly of the discrepancy shall be bid. All labor and materials required to perform the work described shall be included as part of this Contract.

F. It is the intention of this Section of the Specifications to outline minimum requirements to furnish the Owner with a turn-key and fully operating system in cooperation with other trades.

G. It is the intent of the above "Scope" to give the Contractor a general outline of the extent of the Work involved; however, it is not intended to include each, and every item required for the Work. Anything omitted from the "Scope" but shown on the Drawings, or specified later, or necessary for a complete and functioning heating, ventilating and air conditioning system shall be considered a part of the overall "Scope".

H. The Contractor shall rough-in fixtures and equipment furnished by others from rough-in and placement drawings furnished by others. The Contractor shall make final connection to fixtures and equipment furnished by others.

I. Contractor shall participate in the commissioning process; including but not limited to meeting attendance, completion of checklists and participation in functional testing.

J. Refer to 260313 for demolitions requirements.

1.3 RELATED SECTIONS

A. General Conditions

B. Supplementary Conditions

C. Division One

1.4 COOPERATION WITH TRADES

A. Cooperation with trades of adjacent, related, or affected materials or operations shall be considered a part of this work in order to affect timely and accurate placing of work and bring together in proper and correct sequence, the work of such trades.

1.5 REFERENCES

A. National Electrical Code (NEC)

B. American Society for Testing and Materials (ASTM)

C. Underwriter's Laboratories, Inc. (UL)

D. Insulated Cable Engineer's Association (ICEA)

E. National Electrical Manufacturer's Association (NEMA)

F. Institute of Electrical and Electronics’ Engineers (IEEE)

G. American National Standards Institute (ANSI)

H. National Fire Protection Association (NFPA)

I. International Energy Conservation Code (IECC)

1.6 COMPLETE FUNCTIONING OF WORK

A. All work fairly implied as essential to the complete functioning of the electrical systems shown on the Drawings and Specifications shall be completed as part of the work of this Division unless specifically stated otherwise. It is the intention of the Drawings and Specifications to establish the types of the systems, but not set forth each item essential to the functioning of the system. In case of doubt as to the work intended, or in the event of amplification or clarification thereof, the Contractor shall call upon the Architect for supplementary instructions, Drawings, etc.

B. Contractor shall review all pertinent Drawings and adjust his work to all conditions shown there on. Discrepancies between Plans, Specifications, and actual field conditions shall be brought to the prompt attention of the Architect.

1. Approximate location of transformers, feeders, branch circuits, outlets, lighting and power panels, outlets for special systems, etc., are indicated on the Drawings. However, the Drawings, do not give complete and accurate detailed locations of such outlets, conduit runs, etc., and exact locations must be determined by actual field measurement. Such locations will, at all times, be subject to the approval of the Architect.
2. Communicate with the Architect and secure his approval of any outlet (light fixture, receptacle, switch, etc.) location about which there may be the least question. Outlets obviously placed in a location not suitable to the finished room or without specific approval, shall be removed and relocated when so directed by the Architect. Location of light fixtures shall be coordinated with reflected ceiling plans.

C. Additional coordination with mechanical contractor may be required to allow adequate clearances of mechanical equipment, fixtures and associated appurtenances. Contractor to notify Architect and Engineer of unresolved clearances, conflicts or equipment locations.

1.7 SCHEMATIC NATURE OF CONTRACT DOCUMENTS

A. 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 approved shop drawings.

1.8 CONTRACTOR’S QUALIFICATIONS

A. An approved contractor for the work under this division shall be:

a. A specialist in this field and have the personnel, experience, training, and skill, and the organization to provide a practical working system.
b. 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. Perform work by persons qualified to produce workmanship of specified quality. Persons performing electrical work shall be required to be licensed. Onsite supervision, journeyman shall have minimum of journeyman license. Helpers, apprentices shall have minimum of apprentice license.

1.9 DATE OF 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 One for additional requirements.

B. The date of final acceptance shall be documented in writing and signed by the architect, owner and contractor.

1.10 DEFINITIONS AND SYMBOLS

A. General Explanation: A substantial amount of construction and Specification language constitutes definitions for terms found in other Contract Documents, including Drawings which must be recognized as diagrammatic and schematic in nature and not completely descriptive of requirements indicated thereon. Certain terms used in Contract Documents are defined generally in this article, unless defined otherwise in Division 1.

B. Definitions and explanations of this Section are not necessarily either complete or exclusive but are general for work to the extent not stated more explicitly in another provision of the Contract Documents.

C. Indicated: The term "Indicated" is a cross-reference to details, notes or schedules on the Drawings, to other paragraphs or schedules in the Specifications and to similar means of recording requirements in Contract Documents. Where such terms as "Shown", "Noted", "Scheduled", "Specified" and "Detailed" are used in lieu of "Indicated", it is for the purpose of helping the reader locate cross-reference material, and no limitation of location is intended except as specifically shown.

D. Directed: Where not otherwise explained, terms such as "Directed", "Requested", "Accepted", and "Permitted" mean by the Architect or Engineer. However, no such implied meaning will be interpreted to extend the Architect's or Engineer's responsibility into the Contractor's area of construction supervision.

E. Reviewed: Where used in conjunction with the Engineer's response to submittals, requests for information, applications, inquiries, reports and claims by the Contractor the meaning of the term "Reviewed" will be held to limitations of Architect's and Engineer's responsibilities and duties as specified in the General and Supplemental Conditions. In no case will "Reviewed" by

Engineer be interpreted as a release of the Contractor from responsibility to fulfill the terms and requirements of the Contract Documents.

F. Furnish: Except as otherwise defined in greater detail, the term "Furnish" is used to mean supply and deliver to the project site, ready for unloading, unpacking, assembly, installation, etc., as applicable in each instance.

G. Install: Except as otherwise defined in greater detail, the term "Install" is used to describe operations at the project site including unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protection, cleaning and similar operations, as applicable in each instance.

H. Provide: Except as otherwise defined in greater detail, the term "Provide" is used to mean "Furnish and Install", complete and ready for intended use, as applicable in each instance.

I. Installer: Entity (person or firm) engaged by the Contractor or its subcontractor or Sub-contractor for performance of a particular unit of work at the project site, including unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protection, cleaning and similar operations, as applicable in each instance. It is a general requirement that such entities (Installers) be expert in the operations they are engaged to perform.

J. Imperative Language: Used generally in Specifications. Except as otherwise indicated, requirements expressed imperatively are to be performed by the Contractor. For clarity of reading at certain locations, contrasting subjective language is used to describe responsibilities that must be fulfilled indirectly by the Contractor, or when so noted by other identified installers or entities.

K. Minimum Quality/Quantity: In every instance, the quality level or quantity shown or specified is intended as minimum quality level or quantity of work to be performed or provided. Except as otherwise specifically indicated, the actual work may either comply exactly with that minimum (within specified tolerances) or may exceed that minimum within reasonable tolerance limits. In complying with requirements, indicated or scheduled numeric values are either minimums or maximums as noted or as appropriate for the context of the requirements. Refer instances of uncertainty to Owner or Engineer via a request for information (RFI) for decision before proceeding.

L. Abbreviations and Symbols: The language of Specifications and other Contract Documents including Drawings is of an abbreviated type in certain instances and implies words and meanings which will be appropriately interpreted. Actual word abbreviations of a self-explanatory nature have been included in text of Specifications and Drawings. Specific abbreviations and symbols 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 or on a Legend and Symbol Drawing. Trade and industry association names and titles of generally recognized industry 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 Contract Documents so indicate. Except as otherwise indicated, graphic symbols and abbreviations used on Drawings and in Specifications are those recognized in construction industry for indicated purposes. Where not otherwise noted symbols and abbreviations are

defined by ASHRAE Fundamentals Handbook, chapter 39 "Abbreviations and Symbols", ASME and ASPE published standards.

1.11 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to the project properly identified with names, model numbers, types, grades, compliance labels, and other information needed for identification.

B. Deliver products to the project at such time as the project is ready to receive the equipment, pipe or duct properly protected from incidental damage and weather damage.

C. Damaged equipment shall be promptly removed from the site and new, undamaged equipment shall be installed in its place promptly with no additional charge to the Owner.

1.12 SUBMITTALS

A. Coordinate with Division 01 for submittal timetable requirements, unless noted otherwise within thirty (30) days after the Contract is awarded. The Contractor shall submit an electronic copy of a complete set of shop drawings and complete data covering each item of equipment or material. The submittal of each item requiring a submittal must be received by the Architect or Engineer within the above thirty day period. The Architect or Engineer shall not be responsible for any delays or costs incurred due to excessive shop drawing review time for submittals received after the thirty (30) day time limit. The Architect and Engineer will retain a copy of all shop drawings for their files. All literature pertaining to items subject to Shop Drawing submittal shall be submitted at one time. Submittals shall be placed in one electronic file in PDF 8.0 format and bookmarked for individual specification sections. Individual electronic files of submittals for individual specifications shall not be permitted. Each submittal shall include the following items:

1. A cover sheet with the names and addresses of the Project, Architect, MEP Engineer, General Contractor and the Subcontractor making the submittal. The cover sheet shall also contain the section number covering the item or items submitted and the item nomenclature or description.
2. An index page with a listing of all data included in the Submittal.
3. A list of variations page with a listing all variations, including unfurnished or additional required accessories, items or other features, between the submitted equipment and the specified equipment. If there are no variations, then this page shall state "NO VARIATIONS". Where variations affect the work of other Contractors, then the Contractor shall certify on this page that these variations have been fully coordinated with the affected Contractors and that all expenses associated with the variations will be paid by the submitting Contractor. This page will be signed by the submitting Contractor.
4. Equipment information including manufacturer's name and designation, size, performance and capacity data as applicable. All applicable Listings, Labels, Approvals and Standards shall be clearly indicated.
5. Dimensional data and scaled drawings as applicable to show that the submitted equipment will fit the space available with all required Code and maintenance clearances

clearly indicated and labeled at a minimum scale of 1/4" = 1'-0", as required to demonstrate that the alternate or substituted product will fit in the space available.

6. Identification of each item of material or equipment matching that indicated on the Drawings.
7. Sufficient pictorial, descriptive and diagrammatic data on each item to show its conformance with the Drawings and Specifications. Any options or special requirements or accessories shall be so indicated. All applicable information shall be clearly indicated with arrows or another approved method.
8. Additional information as required in other Sections of this Division.
9. Certification by the General Contractor and Subcontractor that the material submitted is in accordance with the Drawings and Specifications, signed and dated in long hand. Submittals that do not comply with the above requirements shall be returned to the Contractor and shall be marked "REVISE AND RESUBMIT".

B. Refer to Division 1 for additional information on shop drawings and submittals.

C. Equipment and materials submittals and shop drawings will be reviewed for compliance with design concept only. It will be assumed that the submitting Contractor has verified that all items submitted can be installed in the space allotted. Review of shop drawings and submittals shall not be considered as a verification or guarantee of measurements or building conditions.

D. Where shop drawings and submittals are marked "REVIEWED", the review of the submittal does not indicate that submittals have been checked in detail nor does it in any way relieve the Contractor from his responsibility to furnish material and perform work as required by the Contract Documents.

E. Shop drawings shall be reviewed and returned to the Contractor with one of the following categories indicated:

1. REVIEWED: Contractor need take no further submittal action, shall include this submittal in the O&M manual and may order the equipment submitted on.
2. REVIEWED AS NOTED: Contractor shall submit a letter verifying that required exceptions to the submittal have been received and complied with including additional accessories or coordination action as noted, and shall include this submittal and compliance letter in the O&M manual. The contractor may order the equipment submitted on at the time of the returned submittal providing the Contractor complies with the exceptions noted.
3. and/or drawings. Contractor shall not order equipment that is not approved. Repetitive requests for substitutions will not be considered.
4. REVISE AND RESUBMIT: Contractor shall resubmit new submittal on material, equipment or method of installation when the alternate or substitute is marked revise and resubmit, the Contractor will automatically be required to furnish the product, material or method named in the Specifications and/or provide as noted on previous shop drawings. Contractor shall not order equipment marked revise and resubmit. Repetitive requests for substitutions will not be considered.
5. CONTRACTOR’S CERTIFICATION REQUIRED: Contractor shall resubmit submittal on material, equipment or method of installation. The Contractor’s stamp is required stating the submittal meets all conditions of the contract documents. The stamp shall be signed by the General Contractor. The submittal will not be reviewed if the stamp is not placed and signed on all shop drawings.

6. MANUFACTURER NOT AS SPECIFIED: Contractor shall resubmit new submittal on material, equipment or method of installation when the alternate or substitute is marked manufacturer not as specified, the Contractor will automatically be required to furnish the product, material or method named in the specifications. Contractor shall not order equipment where submittal is marked manufacturer not as specified. Repetitive requests for substitutions will not be considered.

F. Materials and equipment which are purchased or installed without shop drawing review shall be at the risk of the Contractor and the cost for removal and replacement of such materials and equipment and related work which is judged unsatisfactory by the Owner or Engineer for any reason shall be at the expense of the Contractor. The responsible Contractor shall remove the material and equipment noted above and replace with specified equipment or material at his own expense when directed in writing by the Architect or Engineer.

G. Shop Drawing Submittals shall be complete and checked prior to submission to the Engineer for review.

H. Furnish detailed shop drawings, descriptive literature, physical data and a specification critique for each section indicating "compliance" and/or "variations" for the following items:

1. Fire Alarm System
2. Intrusion System

I. Refer to each specification section for additional requirements.

1.13 OPERATION AND MAINTENANCE MANUALS

A. Prepare maintenance manuals in accordance with Division 1 and in addition to the requirements specified in Division 1, include the following information for equipment items:

1. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.
2. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions.
3. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
4. Servicing instructions and lubrication charts and schedules.

1.14 COORDINATION DRAWINGS

A. Prepare coordination drawings to a scale of 1/4"=1'-0" or larger; detailing major elements, components, and systems of mechanical equipment and materials in relationship with other systems, installations, and building components. Indicate locations where space is limited for installation and access and where sequencing and coordination of installations are of importance to the efficient flow of the Work, including (but not necessarily limited to) the following:

1. Indicate the proposed locations of pipe, duct, equipment, and other materials. Include the following:

    a. Wall and type locations.
    b. Clearances for installing and maintaining insulation.
    c. Locations of light fixtures and sprinkler heads.
    d. Clearances for servicing and maintaining equipment, including tube removal, filter removal, and space for equipment disassembly required for periodic maintenance.
    e. Equipment connections and support details.
    f. Exterior wall and foundation penetrations.
    g. Routing of storm and sanitary sewer piping.
    h. Fire-rated wall and floor penetrations.
    i. Sizes and location of required concrete pads and bases.
    j. Valve stem movement.
    k. Structural floor, wall and roof opening sizes and details.

2. Indicate scheduling, sequencing, movement, and positioning of large equipment into the building during construction.
3. Prepare floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.
4. Prepare reflected ceiling plans to coordinate and integrate installations, air distribution devices, light fixtures, communication systems components, and other ceiling-mounted items.

B. This Contractor shall be responsible for coordination of all items that will affect the installation of the work of this Division. This coordination shall include, but not be limited to: voltage, ampacity, capacity, electrical and piping connections, space requirements, sequence of construction, building requirements and special conditions.

C. By submitting shop drawings on the project, this Contractor is indicating that all necessary coordination has been completed and that the systems, products and equipment submitted can be installed in the building and will operate as specified and intended, in full coordination with all other Contractors and Subcontractors.

1.15 RECORD DRAWINGS

A. Prepare Record Documents in accordance with the requirements of Division 00 and Division 01, in addition to the requirements specified in Division 26 and Division 28.

B. The Contractor shall maintain a separate set of clearly and legibly marked Record Drawings on the job site to record all changes and modifications, including, but not limited to the following: work details, alterations to meet site conditions, and changes made by "Change Order" notices. Mark the drawings with colored pencil(s). These shall be available for review by the Owner, Architect or Engineer during the entire construction stage.

C. The Record Drawings shall be updated concurrently as construction progresses, and in no case less frequently than a daily basis. They shall indicate accurate dimensions for all buried or concealed work, precise locations of all concealed pipe or duct, locations of all concealed

valves, controls and devices and any deviations from the work shown on the Construction Documents. All dimensions shall include at least two dimensions to permanent structure points.

D. Engage the services of a Land Surveyor or Professional Engineer registered in the state in which the project is located as specified herein to record the locations and invert elevations of underground installations.

E. If the Contractor does not keep an accurate set of Record Drawings, the pay request may be altered or delayed at the request of the Architect. Delivery of Record Documents is a condition of final acceptance. Record Drawings shall be furnished in addition to Shop Drawings.

F. The Contractor shall submit an electronic copy of the record documents in PDF format and one (1) full size set of Record Drawing prints to the Architect or Engineer for review prior to scheduling the final inspection at the completion of the work. The drawings shall have the name(s) and seal(s) of the Engineer(s) removed or blanked out and shall be clearly marked and signed on each sheet as follows:

1. CERTIFIED RECORD DRAWINGS
2. DATE:
3. (NAME OF GENERAL CONTRACTOR)
4. BY:_____

    a. (SIGNATURE)

5. (NAME OF SUBCONTRACTOR)
6. BY:_____

    a. (SIGNATURE)

1.16 CERTIFICATIONS AND TEST REPORTS

A. Submit a detailed schedule for completion and testing of each system indicating scheduled dates for completion of system installation and outlining tests to be performed and schedule date for each test. This detailed completion and test schedule shall be submittal at least 90 days before the projected Project completion date.

B. Test result reporting forms shall be submitted for review no later than the date of the detailed schedule submitted.

C. Submit 4 copies of all certifications and test reports to the Architect or Engineer for review adequately in advance of completion of the Work to allow for remedial action as required to correct deficiencies discovered in equipment and systems.

D. Certifications and test reports to be submitted shall include, but not be limited to those items outlined in Section of Division 26.

1.17 MAINTENANCE MANUALS

A. Coordinate with Division 1 for maintenance manual requirements, unless noted otherwise bind together in “D ring type” binders by National model no. 79-883 or equal, binders shall be large enough to allow ¼” of spare capacity. Three (3) sets of all approved shop drawing submittals, fabrication drawings, bulletins, maintenance instructions, operating instructions and parts exploded views and lists for each and every piece of equipment furnished under this Specification. All sections shall be typed and indexed into sections and labeled for easy reference and shall utilize the individual specification section numbers shown in the Electrical Specifications as an organization guideline. Bulletins containing information about equipment that is not installed on the project shall be properly marked up or stripped and reassembled. All pertinent information required by the Owner for proper operation and maintenance of equipment supplied by Division 26 shall be clearly and legibly set forth in memoranda that shall, likewise, be bound with bulletins.

B. Prepare maintenance manuals in accordance with Special Project Conditions, in addition to the requirements specified in Division 26 and Division 2, include the following information for equipment items:

1. Identifying names, name tags designations and locations for all equipment.
2. Reviewed shop drawing submittals with exceptions noted compliance letter.
3. Fabrication drawings.
4. Equipment and device bulletins and data sheets clearly highlighted to show equipment installed on the project and including performance curves and data as applicable, i.e., description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and model numbers of replacement parts.
5. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions.
6. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions, servicing instructions and lubrication charts and schedules.
7. Equipment name plate data.
8. Wiring diagrams.
9. Exploded parts views and parts lists for all equipment and devices.
10. Color coding charts for all painted equipment and conduit.
11. Location and listing of all spare parts and special keys and tools furnished to the Owner.
12. Furnish recommended lubrication schedule for all required lubrication points with listing of type and approximate amount of lubricant required.

C. Refer to Division 1 for additional information on Operating and Maintenance Manuals.

D. Operating and Maintenance Manuals shall be turned over to the Owner or Engineer a minimum of 14 working days prior to the beginning of the operator training period.

1.18 OPERATOR TRAINING

A. The Contractor shall furnish the services of factory trained specialists to instruct the Owner's operating personnel. The Owner's operator training shall include 12 hours of onsite training in three 4 hour shifts.

B. 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.

C. Refer to other Division 26 Sections for additional Operator Training requirements.

1.19 SITE VISITATION

A. Visit the site of the proposed construction in order to fully understand the facilities, difficulties and restriction attending the execution of the work.

B. Before submitting a bid, it will be necessary for each Contractor whose work is involved to visit the site and ascertain for himself the conditions to be met therein in installing his work and make due provision for same in his bid. It will be assumed that this Contractor in submitting his bid has visited the premises and that his bid covers all work necessary to properly install the equipment shown. Failure on the part of the Contractor to comply with this requirement shall not be considered justification for the omission or faulty installation of any work covered by these Specifications and Drawings.

C. Understand the existing utilities from which services will be supplied; verify locations of utility services and determine requirements for connections.

D. Determine in advance that equipment and materials proposed for installation fit into the confines indicated.

1.20 WARRANTY

A. The undertaking of the work described in this Division shall be considered equivalent to the issuance, as part of this work, of a specific guarantee extending one year beyond the date of completion of work and acceptance by Owner, against defects in materials and workmanship. Materials, appliances and labor necessary to effect repairs and replacement so as to maintain said work in good functioning order shall be provided as required. Replacements necessitated by normal wear in use or by Owner's abuse are not included under this guarantee.

B. All normal and extended warranties shall include parts, labor, miscellaneous materials, travel time, incidental expenses, freight/shipping, refrigerant, oils, lubricants, belts, filters and any expenses related to service call required to diagnose warranty problems.

1.21 TRANSFER OF ELECTRONIC FILES

A. Project documents are not intended or represented to be suitable for reuse by Architect/Owner or others on extensions of this project or on any other project. Any such reuse or modification without written verification or adaptation by Engineer, as appropriate for the specific purpose intended, will be at Architect/Owner's risk and without liability or legal exposure to Engineer or its consultants from all claims, damages, losses and expense, including attorney's fees arising out of or resulting thereof.

B. Because data stored in electric media format can deteriorate or be modified inadvertently, or otherwise without authorization of the data's creator, the party receiving the electronic files agrees that it will perform acceptance tests or procedures within sixty (60) days of receipt, after which time the receiving party shall be deemed to have accepted the data thus transferred to be acceptable. Any errors detected within the sixty (60) day acceptance period will be corrected by the party delivering the electronic files. Engineer is not responsible for maintaining documents stored in electronic media format after acceptance by the Architect/Owner.

C. When transferring documents in electronic media format, Engineer makes no representations as to the long term compatibility, usability or readability of documents resulting from the use of software application packages, operating systems, or computer hardware differing from those used by Engineer at the beginning of the Project.

D. Any reuse or modifications will be Contractor's sole risk and without liability or legal exposure to Architect, Engineer or any consultant.

E. The Texas Board of Architectural Examiners (TBAE) has stated that it is in violation of Texas law for persons other than the Architect of record to revise the Architectural drawings without the Architect's written consent.

1. It is agreed that "MEP" hard copy or computer-generated documents will not be issued to any other party except directly to the Architect/Owner. The contract documents are contractually copyrighted and cannot be used for any other project or purpose except as specifically indicated in AIA B-141 Standard Form of Agreement Between Architect and Owner.
2. If the client, Architect or Owner of the project requires electronic media for "record purposes", then AutoCAD/ Revit documents will be prepared by Engineer on electronic media such as removable memory devices, flash drives or CD's. These documents can also be submitted via file transfer protocols. AutoCAD/ Revit files will be submitted with all title block references intact to permit the end user to only view and plot the drawings. Revisions will not be permitted in this configuration.
3. At the Architect/Owner's request, Engineer will assist the Contractor in the preparation of the submittals and prepare one copy of AutoCAD/ Revit files on electronic media or submit through file transfer protocols. The electronic media will be prepared with all indicia of documents ownership removed. The electronic media will be prepared in a ".rvt" or ".dwg" format to permit the end user to revise the drawings.

PART 2 - PRODUCTS

2.1 SUBSTITUTIONS

A. The names and manufacturers and model numbers have been used in the Contract documents to establish types of equipment and standards of quality. Where more than one manufacturer is named for a specific item of equipment, only one of the specified manufacturers will be considered for approval. Where only one manufacturer is mentioned with the phrase "or approved equal", Contractor may submit an alternate manufacturer for consideration, provided the following conditions are met:

1. Submit alternate equipment with complete descriptive data in shop drawing form. Provide sample of equipment upon request for review by Architect. Samples will be returned if requested in writing.
2. Alternate equipment must be equal from the standpoint of materials, construction and performance.
3. Alternate submittal must be presented to the Engineer/Architect ten (10) days prior to bid date for approval.

B. The Architect and Engineer shall be the sole judge of quality and equivalence of equipment, materials and methods.

2.2 UL LISTING

A. All materials and products used on this project shall be listed by Underwriters' Laboratories.

2.3 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.

2.4 ESCUTCHEONS

A. Provide heavy chrome or nickel plated plates, of approved pattern, on conduit passing through walls, floors and ceilings in finished areas. Where conduit passes through a sleeve, no point of the conduit shall touch the building construction. Caulk around such conduit with sufficient layers of two hour rated firesafing by Thermafiber 4.0 P.C.F. density, U.S.G. fire test 4/11/78 and seal off openings between conduit and sleeves with non-hardening mastic prior to application of escutcheon plate. Escutcheons shall be Gravler Sure-Lock, or approved equal.

2.5 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 Code requirements. Physical dimensions and arrangement of equipment shall be subject to the approval of the Architect.

2.6 PAINTING

A. All factory assembled equipment for electrical work, except light fixtures, that normally is delivered with a factory applied finish shall be delivered with a hard surface factory applied finish such as baked-on machinery enamel which will not require additional field painting. The finish shall consist of not less than 2 coats of medium gray color paint USA No. 61 Munsell Notation 8-3G, 6. 10/0.54 enamel. This Contractor shall protect this finish from damage due to construction operations until acceptance of the building. He shall be responsible for satisfactorily restoring any such finishes or replacing equipment that becomes stained or damaged.

2.7 RACEWAY IDENTIFICATION

A. Conduit Systems: Provide adequate marking of major conduit which is exposed or concealed in accessible spaces to distinguish each run as either a power or signal/communication conduit. Use red banding with black lettering except as otherwise indicated. Provide self-adhesive or snap-on type plastic markers. Locate markers at ends of conduit runs, on pull boxes, on junction boxes 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 spacings of not more than 50 feet along each run of conduit.

B. Underground Cable Identification: Bury a continuous, preprinted, bright colored plastic ribbon cable marker with each underground cable (or group of cables), regardless of whether conductors are in conduit, duct bank, or direct buried. Locate each directly over cables, 6 to 8 inches below finished grade.

C. 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. Care shall be taken not to obliterate this nameplate in any way.
2. Prohibited Markings: Markings which are intended to identify the manufacturer, vendor, or other source from which the material has been obtained are prohibited for installation within public, tenant, or common areas within the project. Also, prohibited are materials or devices which bear evidence that markings or insignias have been removed. Certification, testing (example, Underwriters’ Laboratories, Inc.), and approval labels are exceptions to this requirement.
3. Warning Signs: Provide warning signs where there is hazardous exposure associated with access to or operation of facilities. Provide text of sufficient clarity and lettering of sufficient size to convey adequate information at each location; mount permanently in an

appropriate and effective location. Comply with recognized industry standards for color and design.

4. Operational Tags: Where needed for proper and adequate information on operation and maintenance of electrical system, provide tags of plasticized card stock, either preprinted or hand printed.

PART 3 - EXECUTION

3.1 EXCAVATING AND BACKFILLING

A. Trenching and backfilling and other earthwork operations required to install the facilities specified herein shall conform to the applicable requirements of Division 2 (95% of maximum standard density). Where trenching or excavation is required in improved areas, the backfill shall be compacted to a condition equal to that of adjacent undisturbed earth and the surface of the area restored to the condition existing prior to trenching or excavating operations. Provide a minimum of 3" of sand underneath all conduits. The plans indicate information pertaining to surface and sub-surface obstructions; however, this information is not guaranteed. Should obstructions be encountered whether or not shown, the Contractor shall alter routing of new work, reroute existing lines, remove obstructions where permitted, or otherwise perform whatever work is necessary to satisfy the purpose of new work and leave existing surfaces and structures in a satisfactory and serviceable condition. All work shall comply with OSHA Standards.

3.2 WORKMANSHIP AND CONCEALMENT

A. The work of this Section shall be performed by workman skilled in their trade. Installation shall be consistent in completeness whether concealed or exposed. Each item of electrical work shall be concealed in walls, chases, under floors and above ceilings except:

1. Where shown to be exposed.
2. Where exposure is necessary to the proper function.

3.3 SLEEVES, CUTTING AND PATCHING

A. This section shall be responsible for placing sleeves for all conduit passing through walls, partitions, sound walls, beams, floors, roof, etc. Sleeves through below-grade walls shall use water-tight fitting manufactured by O-Z/Gedney.

B. All cutting and patching will be done under another Division, but this Section will be responsible for timely performance of this work and layout of holes and setting sleeves.

C. All un-used sleeves shall be sealed with 2 hour UL approved fire sealant manufactured by "3M" or approved equal.

D. Refer to 260533 for additional requirements.

3.4 CONTROL PANELS

A. Install all Panels in accordance with the National Electrical Code, industry standards and as shown on the drawings.

B. Panels mounted in telecom, MDF, IDF, mechanical/electrical rooms shall be mounted at a working height not requiring a ladder when wall space is available. Installation of these devices at greater elevations shall be approved by the Engineer. Contractor shall provide a coordination sketch of each mechanical/electrical room noting locations and mounting heights of all electrical devices (note bottom and top elevations) shown to be installed. Sketches shall be provided to the Engineer for review and the general contractor for coordination with other trades working in these rooms.

3.5 CLEANING

A. Touch-up and refinish scratches and marred surfaces on panels.

3.6 CORROSIVE AREAS

A. In areas of a corrosive nature, which include but are not limited to the following: pool equipment rooms, cooling towers and areas subject to salt air, etc., provide NEMA 4X stainless steel or fiberglass reinforced enclosures for contactors, panel boards, controllers, starters, disconnects and materials used as supporting means (i.e. plastibond unistrut, pipe, fittings). The use of spray on coating may be acceptable in some applications.

3.7 TESTS AND INSPECTIONS

A. Tests and inspection requirements shall be coordinated with Division 01.

B. Date for final acceptance test shall be sufficiently in advance of completion date of contract to permit alterations or adjustments necessary to achieve proper functioning of equipment prior to contract completion date.

C. Conduct re-tests as directed by Architect on portions of work or equipment altered or adjusted as determined to be necessary by final acceptance test. No resultant delay or consumption of time as a result of such necessary re-test beyond contract completion date shall relieve Contractor of his responsibility under contract.

D. Put equipment into service under normal conditions, collectively and separately, as may be required to determine satisfactory operation. Demonstrate equipment to operate in accordance with requirements of these specifications. Perform tests in the presence of Architect. Furnish instruments and personnel required for tests.

E. Final Inspection

1. At the time designated by the Architect, the entire system shall be inspected by the Architect and Engineer. The contractor or his representative shall be present at this inspection.
2. Panels shall be cleaned and in operating condition.
3. Certificates and documents required hereinbefore shall be in order and presented to the Architect prior to inspection.
4. Panel covers, junction box covers, etc., shall be removed for visual inspection of the wire, bus bars, etc.
5. After the inspection, any items which are noted as needing to be changed or corrected in order to comply with these specifications and the drawings shall be accomplished without delay.

END OF SECTION 280500

SECTION 284609 - FIRE ALARM SYSTEM WITH VOICE EVACUATION

PART 1 - GENERAL

1.1 SCOPE

A. The contractor shall reuse the existing distributed microprocessor based 24VDC, electrically supervised, MULTIPLEX, integrated fire alarm system as specified and required by applicable codes. The system shall include, but not be limited to, all control equipment, remote transponders, power supplies, signal initiating and signaling devices, conduit wire, fittings, and all other accessories required to provide a complete and operable system. Provide new devices, hardware, and software to add new devices for level 1 and level 2 new gym addition.

B. All equipment, materials, accessories, devices, etc. covered by the specifications shall be new and unused and shall be U.L. listed for their intended use.

C. The system shall operate as a non-coded, continuous sounding system which will sound alarm devices until manually silenced, as herein specified.

D. The system shall be wired as a Class B supervised system for all circuits.

1.2 REFERENCE STANDARDS

A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.

B. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

D. NFPA 72 - National Fire Alarm and Signaling Code; Most Recent Edition Cited by Referring Code or Reference Standard.

E. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2024.

F. NFPA 101 - Life Safety Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

G. NFPA 262 - Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces; Current Edition, Including All Revisions.

H. UL 38 - Standard for Manual Signaling Boxes for Fire Alarm Systems; Current Edition, Including All Revisions.

I. UL 228 - Safety Door Closers-Holders, with or without Integral Smoke Detectors; 2008.

J. UL 268 - Standard for Smoke Detectors for Fire Alarm Systems; Current Edition, Including All Revisions.

K. UL 268A - Standard for Smoke Detectors for Duct Application; Current Edition, Including All Revisions.

L. UL 464 - Standard for Audible Signaling Devices for Fire Alarm and Signaling Systems, Including Accessories; Current Edition, Including All Revisions.

M. UL 521 - Standard for Heat Detectors for Fire Protective Signaling Systems; Current Edition, Including All Revisions.

N. UL 864 - Control Units and Accessories for Fire Alarm Systems; Current Edition, Including All Revisions.

O. UL 1638 - Standard for Visible Signaling Devices for Fire Alarm and Signaling Systems, Including Accessories; Current Edition, Including All Revisions.

P. UL 1971 - Standard for Signaling Devices for the Hearing Impaired; Current Edition, Including All Revisions.

Q. UL 2034 - Standard for Single and Multiple Station Carbon Monoxide Alarms; Current Edition, Including All Revisions.

R. UL 2075 - Standard for Gas and Vapor Detectors and Sensors; Current Edition, Including All Revisions.

1.3 INSTALLING CONTRACTOR’S RESPONSIBILITY

A. The installing fire alarm contractor is responsible for the design of a code compliant system, which meets the intent of all State and Local Authority Having Jurisdiction Codes and their adopted amendments along all permitting of such plans and associated permit fees. Reference and coordinate with all contract specifications and plans.

1.4 ACCEPTABLE MANUFACTURERS

A. Provide the following manufacturers:

1. Simplex

B. Alternate Manufacturers

1. Equipment from other manufacturer's or supplier's may be considered as an equal to that specified provided that completely marked and identified catalog sheets of all proposed equipment is provided to the architect/engineer for review ten (10) days prior to the date of bid for evaluation. In addition, a list of the contractor's qualifications and any exceptions to the specifications must be provided for review. Approval for any such substitution of

equipment must be obtained in writing from the architect/engineer for five (5) days prior to bid.

1.5 GENERAL REQUIREMENTS

A. Contractor Qualifications:

1. The equipment supplier shall be an authorized and designated representative of the Fire Alarm Manufacturer to sell, install, and service the proposed manufacturer's equipment.
2. The equipment supplier and installing contractor shall be licensed by the State Fire Marshal to sell, install, and service fire alarm systems as required by State Insurance Code.
3. The installing contractor and/or equipment supplier shall have on his staff a minimum of three (3) installation superintendents who are licensed by the State Fire Marshall's office for such purpose and under whose supervision installation, final connections, and check out will take place as required by the State Insurance Code.
4. The installing contractor or equipment supplier shall have on staff a minimum of one (1) certified NICET Level III state licensed fire alarm planner under whose supervision system design shall take place.
5. The installing contractor shall provide 24-hour, 365 days per year emergency service with qualified and state licensed service technicians.
6. The installing contractor shall have been actively engaged in the business of selling, installing, and servicing fire alarm systems for at least ten (10) years.

1.6 SUBMITTALS

A. The installing contractor and/or equipment manufacturer shall provide complete and detailed shop drawings and include:

1. Control panel configuration including wiring and interconnection schematics.
2. Complete point to point wiring diagram showing terminal connections to all system devices.
3. Riser wiring diagram and associated zoning/addressing configurations with associated conduit sizes.
4. Complete floor plan drawings locating all devices associated with the fire alarm system. Floor plan drawings shall include conduit and wiring routing complete with conduit sizing and number of conductors by type. Floor plans shall be on AutoCAD v.12.
5. Factory data sheets on each piece of equipment to be used and so marked as to model, dimensions, size, voltage, and configuration.
6. Detailed system description in this specification format describing system functions and operation. All specification variations and deviations shall be clearly noted and marked.
7. Complete Bill of Material for reference.
8. Programming matrix defining all input/output functions and zoning.
9. Power supply and battery calculations.
10. A written certification from the manufacturer stating that the distributor is authorized to sell, service and install the proposed fire alarm system.

B. Submittal shall include documentation confirming all qualifications have been met. Submittals without qualification documentation shall be returned "Revise and Resubmit".

C. All submittal data will be in bound form with contractor's name, supplier's name, project name, and state fire alarm license number adequately identified.

1.7 COORDINATION

A. It shall be the responsibility of the installing contractor to coordinate all requirements surrounding installation of the fire alarm system with all trades including, but not exclusive of elevator, electrical contractor, sprinkler contractor, and HVAC/controls contractor and intercom system. Adequate coordination shall be provided to insure proper installation and interface to all peripheral items required to interact with the fire alarm and communication system to provide a complete and functional life safety system.

PART 2 - PRODUCTS

2.1 SYSTEM FUNCTIONAL OPERATION

A. ALARM DETECTION

1. When a fire alarm condition is detected via the main fire control panel by any of the system alarm initiating devices, the following functions shall occur:

    a. The system common alarm LED on the CPU Module shall flash. The internal audible trouble device shall sound Acknowledging the alarm condition shall silence the audible trouble device and revert the flashing common alarm LEDs to a steady state
    b. A multi-character back-lit LCD Display shall indicate all applicable information associated with the alarm condition including zone, device type, device location, and time of alarm Location and zoning messages shall be custom field programmed to respective premises
    c. Any remote annunciator LCD display associated with the alarm zone shall be activated as herein specified
    d. All automatic events programmed to the alarm point shall be executed and the associated indicating devices and/or outputs activated
    e. Alarm tones shall sound throughout the facility. Upon expiration of the alert tone, a digitized predetermined voice evacuation message shall be automatically transmitted throughout the facility The system shall have the capability to generate multiple distinct digital messages as determined by event-initiated programs
    f. Activate all visual alarm notification devices throughout the facility
    g. Recall elevators to ground floor as specified herein, or to the alternate floor if the alarm condition originates on the ground floor
    h. Unlock all electrically locked doors
    i. De-activate HVAC systems over 2,000 cfm
    j. Release all smoke doors, fire doors, fire coiling doors, fire smoke dampers and fire shutters.
    k. Activate the smoke control system for the atrium

B. System Trouble Detection

1. When a trouble condition is detected by the CPU, one of the system initiating, alarm or SLC circuits, the following functions shall immediately occur:

    a. The system trouble LED on the CPU module shall flash and the internal audible trouble device shall sound. Acknowledgment of the trouble condition shall silence the audible trouble device and cause all trouble LEDs to illuminate steady.
    b. The multi-character alphanumeric LCD annunciator shall display all applicable information via the alphanumeric display associated with the respective trouble condition and its location.
    c. The system common trouble indicator on associated remote annunciators shall be illuminated as specified herein.

C. Auxiliary Control

1. All designated "non-silenceable" auxiliary control functions shall remain in operation (even upon silencing of audible alarms) until such time as the control panel is cleared and reset manually (i.e., fan control outputs, central station interface, elevator recall interface, etc.).
2. Activation of duct smoke detectors associated fans shall shutdown their respective units immediately in addition to identifying the condition as herein specified. Duct detectors shall be programmed as a supervisory condition per NFPA 72.

D. System Supervisory Detection

1. When a supervisory condition is detected by the fire alarm control panel, the following functions shall occur:

    a. The fire alarm control panel supervisory indicator shall flash, and the internal audible device shall sound Acknowledgment of the supervisory condition shall silence the audible device and cause the supervisory indicator to illuminate steady
    b. The multi-character liquid crystal display shall display all applicable information associated with the respective supervisory condition.
    c. Display the system status change on the remote annunciators

E. Remote Off-site Monitoring

1. The remote off-site monitoring system shall transmit point specific alarm, trouble, and supervisory signals to an Approved Central Supervising Station (Central Station connection, phone lines or cellular connectivity service provided by Owner).

F. Fire Drill Control

1. Provide a fire drill switch located on the Fire Alarm Control Panel. When activated, this switch will activate all horns and visual devices (strobes) for a fire drill. It shall not release fire shutter, shut down air handling equipment or recall elevators. If a fire alarm condition is detected, the system shall operate as defined in part A - "Alarm Detection" of this section.

2.2 ZONING

A. The system shall have the inherent capability to employ "Intelligent" smoke detectors and addressable interface devices capable of being recognized and annunciated at the main control panel on an individual basis. All zoning/device location information shall be totally field programmable to exact job requirements as approved by the architect/engineer.

B. The system shall utilize remote amplifier cabinets for distributed voice communications (if needed), notification appliance circuits, and auxiliary control output circuits. Remote transponder panels shall communicate with the main CPU via the SLC data loop and be capable of being intermixed on the same loop as intelligent smoke detection and control modules.

2.3 FIRE ALARM CONTROL PANEL

A. Central Processing Unit Module (CPU)

1. The CPU shall contain and execute all custom time control functions or control-by-event programs for specified events including 'Holiday' exceptions. Time control events/programs shall be automatically overridden by priority fire alarm events. All programs shall be held in non-volatile programmable memory and shall not be lost even if both system primary and secondary power failure occurs.
2. System CPU shall also provide for non-alarm points for non-fire, low priority building functions. The CPU shall provide capability of multi-stage signaling, tornado warning, emergency radio communication enhancement system, positive alarm sequencing as well as remote control system operation.

B. Display Interface Board (DIA)

1. The DIA shall provide a multi-character back-lit, super-twist Liquid Crystal Display (LCD). It shall provide Light-Emitting Diodes (LED's) for AC POWER; SYSTEM ALARM; SYSTEM TROUBLE; DISPLAY TROUBLE; and DISABLE.
2. The DIA shall provide a 25-key membrane keypad with control capability to command all system functions, status readouts, manual control action, and entry of any alphabetic or numeric information. The keypad shall include means to enter multiple five-digit passwords to prevent unauthorized manual control or programming.

C. Control Switches

1. Acknowledge/step Switch
2. Signal Silence Switch
3. System Reset Switch
4. System Test Switch
5. Lamp Test

D. System Outputs

1. The system shall provide the following outputs:

a. One port for laptop and/or modem

b. One port for supervised remote LCD annunciators (RS-485)

E. Loop Interface (SLC)

1. The CPU shall communicate and provide power to all devices on its loop over a single pair of wires. The CPU shall receive digital/ANALOG information from all "intelligent" detectors and shall process this information to determine normal, alarm, trouble, and sensitivity conditions. The analog information may be used for automatic test and determination of maintenance requirements and be U.L. listed for such use. The CPU module shall individually monitor all "intelligent" detectors for sensitivity variation initiating a trouble condition should detector sensitivity "drift" become excessive. The system control unit shall have the capability to remotely read each detector's sensitivity in % obscuration, and if necessary, electronically adjust the detector sensitivity as required for existing conditions within U.L. recommended limits. In addition, the system shall incorporate a "day/night" sensitivity feature. The system shall provide capability to program each individual detector for multiple 'pre-alarm' conditions. Each 'pre-alarm' level shall be field programmable as a function of the programmed alarm level. The system shall allow designated control-by-event actions to occur as may be required prior to any sensor reaching the designated alarm point.

F. Non-Lock Walk Test

1. The system shall include a special non-lock "walk test" mode. The walk test mode shall incorporate a time-out feature to return system to normal. Test results shall be capable of being generated and displayed on the LCD annunciator.

G. Automatic Detector Test

1. The system shall include a special automatic detector test feature which permits reading and adjustment of the sensitivity of all intelligent detectors from the main control panel. In addition, the automatic test feature shall also permit the functional testing of any "intelligent" detector or addressable interface device individually from the main control panel. An automatic detector test shall occur automatically fourteen times each twenty-four-hour period or be initiated manually from the FACP as desired. Automatic detector test sequencing shall be terminated upon receipt of a true alarm condition.

H. Special System Reports

1. The system shall have the ability to generate and print, upon command, system and point status reports. Selection of 'system' read status provides the operator with global system programming information. Selection of 'point' read status provides the operator with selected individual point programming data. The system shall also provide the capability to print out a detailed 'history' report from system history file upon command.

I. Field Programming

1. The system shall be 100% field programmable without the need for external computers or PROM programmers and shall NOT require replacement of memory IC's. Systems requiring factory programming/re-programming OR REPLACEMENT OF MEMORY I.C. CHIPS shall not be acceptable. All programs shall be stored in non-volatile RAM

memory. Programming shall be accomplished only after entering an appropriate and pre-selected five-digit password security code. System programming mode shall not require the system to be taken off-line nor prohibit the system from performing its normal operations and routines. The system shall be capable of revising/changing programmed functions or system expansion at any time subsequent to initialization as described herein without factory modifications or factory programming. Field programming via the use of external computers may be considered provided programming can be accomplished on-site and the owner permanently furnished with required programming apparatus and software as part of this contract.

J. Event History

1. The main fire alarm panel shall have the resident ability to store a minimum of 600 system events in chronological order of occurrence. Event history shall include all system alarms, troubles, operator actions, unverified alarms, circuit/point alterations, and component failures. Events shall be time and date stamped. Events shall be stored in non-volatile buffer memory. Access to history buffer shall be secured via five digit password security code.

K. Power Supply

1. The power supply shall provide all control panel and peripheral power needs with filtered power as well as regulated 24VDC power for external audio-visual devices. The audio-visual power may be increased as needed by adding additional modular expansion power supplies. All power supplies shall be designed to meet U.L. and NFPA requirements for POWER-LIMITED operation on all external signaling lines, including initiating circuits and indicating circuits.
2. Input power shall be 120VAC 60Hz. The power supply shall provide internal supervised batteries and automatic charger. The power supply shall provide both positive and negative ground fault supervision, battery/charger fail condition, A.C. power fail indicators. The power supply shall also provide supervision of modular expansion power supplies as may be required.
3. Batteries shall have 24 hours of standby capacity and 15 minutes of alarm capacity. Battery charger shall recharge batteries from full discharge to full charge over a 24-hour period. Switching from normal power to battery power and back shall occur automatically.

2.4 VOICE COMMUNICATIONS

A. The voice communications panel shall be modular in design utilizing solid state MICROPROCESSOR circuitry. The voice evacuation system shall integrate with the main fire alarm control panel. Side car voice evacuation systems are not acceptable.

B. Communications Controls: The communications control panel shall incorporate the following controls and indicators:

1. All call
2. General alarm
3. Audio trouble LED
4. AUDIO LEVEL LED
5. Manual tone/MESSAGE select switches with LED indicators

6. Communications zone select switches and select indicators
7. Communications monitor speaker with volume control
8. Dynamic paging microphone

C. Paging

1. The microprocessor based one way paging system shall be provided with a means to selectively activate voice, tones, or digitized messages to any or all zones in the system via electronic membrane touch-pad controls. In addition, visual indication by zone will be provided.
2. Each audio/speaker circuit will be totally supervised for opens, shorts or grounds with direct shorts prohibiting selection of the respective zone. All audio circuits shall be POWER LIMITED. Each speaker zone shall be provided with an amber trouble LED for circuit trouble conditions and an active/on LED indicator.
3. Alarm/Paging zones shall be provided as required.

D. Alarm Electronics

1. The voice communications center shall be a microprocessor based, supervised, multi-function, audio generator. The communications generator shall contain:

    a. Independent Voice communications CPU b Non-volatile RAM memory
    b. One custom digitized message circuits
    c. Up to four selectable tone generator/oscillators
    d. Each sub-circuit of the communications center shall be fully supervised and failure of any tone oscillator or digital message generator shall revert the system to the default standby generator

2. The system shall be provided with a custom field programmable digitized message.
3. The system shall provide adequate audio amplification. The system shall be capable of amplifier capacity and expansion as required. Each amplifier shall be continuously monitored electronically for proper output level. Each unit shall be equipped with diagnostic indicators. Each amplifier shall provide a minimum of 50 watts of 25 VRMS of power. Each unit shall be equipped with its own individual power/pilot LED, audio input trouble LED, battery input trouble LED, and amplifier trouble/fail LED. Provide amplification for 1/2 watt per speaker plus 25% spare capacity. Electrical Contractor shall provide and install a 120 VAC dedicated circuit to each remote amplifier cabinet (if needed).

2.5 FIELD DEVICES

A. Multi Criteria Smoke Heat and Infrared Detector:

1. Provide intelligent multi criteria detector. The intelligent multi criteria detector shall be an addressable device that is designed to monitor a minimum of photoelectric and thermal technologies in a single sensing device. The design shall include the ability to adapt to its environment by utilizing a built-in microprocessor to determine its environment and choose the appropriate sensing settings. The detector design shall allow a wide sensitivity window,

no less than 1 to 4% per foot obscuration. This detector shall utilize advanced electronics that react to slow smoldering fires and thermal properties all within a single sensing device.

2. The microprocessor design shall be capable of selecting the appropriate sensitivity levels based on the environment type it is in (office, manufacturing, kitchen etc.) and then have the ability to automatically change the setting as the environment changes (as walls are moved or as the occupancy changes).
3. 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.
4. The detector shall be semi-flush ceiling mounted and be provided with modular detector head with twist-lock base.

B. Intelligent Duct Detector

1. Provide duct mounted "intelligent" photoelectric smoke detectors. Detectors shall operate on the same principles and exhibit the same basic characteristics as area type "intelligent" photoelectric smoke sensors. The unit shall be capable of interchanging/accepting either photo-electronic or ionization type 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.
2. The unit shall consist of a clear molded plastic enclosure with integral conduit knockouts. The unit shall be provided with clear faceplate cover 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. Detectors shall be installed per NFPA 90A and be listed with the fire alarm control panel. A remote LED shall be located on the corridor ceiling adjacent to the respective detector where detectors are not plainly visible or concealed from view.

C. Intelligent Thermal Detectors

1. Provide analog, fixed temperature, thermal detectors. The detectors shall use dual electronic thermostats to measure temperature levels in the chamber and shall, on command from the control panel, send data to the panel representing the analog temperature level.
2. The detectors shall provide dual alarm and power/status LED's. Status LEDs shall flash under normal conditions, indicating that the detector is operational and in regular communication with the control panel. Both LED's may be placed into steady illumination by the control panel, indicating that an alarm condition has been detected. An output connection shall also be provided in the base to connect an external remote alarm LED.
3. The detector shall be semi-flush ceiling mounted and be provided with modular detector head with twist-lock base.

D. Conventional Weatherproof Thermal Detector

1. Provide when heat detection devices are located in harsh and/or moist environments, such as showers and similar areas, which are subject to high humidity, the following device shall

be provided. Weatherproof Heat Detector 135°F Rate Compensated shall be provided. The detector shall mount in a weatherproof 4" electrical box with 1/2" NPT threaded hub. This detector shall be connected to an addressable monitor module.

E. Addressable Manual Stations

1. Provide Manual stations.

a. The manual stations shall contain the intelligence for reporting address, identity, alarm, and trouble to the fire alarm control panel
b. The manual pull station shall be constructed of durable molded polycarbonate material and shall be RED in color with raised white lettering Stations shall be of the dual action type
c. All manual pull stations shall be provided with an STI-1100 series clear plastic cover with integral horn.

F. Monitor Module

1. Provide 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.

G. Control Module

1. Provide control/relay modules 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 using rotary decimal switches. No binary coding shall be required. A status LED shall be provided which shall flash under normal conditions, indicating that the control module is operational and in regular communication with the control panel. The LED shall illuminate steadily when the device is actuated via the fire alarm control panel.

H. Remote LCD Alpha-Numeric Annunciators with Remote Microphone and Switches

1. Provide a multi-character remote LCD alpha-numeric annunciator or approved equal to annunciate all system events and duplicate the displayed status at the main FACP. The annunciator shall be a backlit eighty-character LCD display and operate via the system RS485 or RS232 serial output terminal from the main FACP. The LCD display shall automatically illuminate upon receipt of an alarm or trouble condition. The illumination source shall extinguish during normal/standby mode to conserve power. The unit shall operate from FACP 24VDC power and function during system power failure while the system resides on standby batteries. The remote LCD annunciator shall include:

a. Integral time-date clock
b. Time-date select switch
c. Time-date/contrast adjust
d. Display/step switch

e. System reset
f. System silence
g. System acknowledge
h. Integral trouble buzzer
i. Point enable/disable capability
j. Full QWERTY keypad for system programming

2. Annunciator shall upon command display the first system alarm, last alarm, and system alarm count. The unit shall be equipped with an integral lamp test feature. The unit shall be semi flush mounted where shown.
3. Provide enclosure with a remote microphone with selector switches.

I. Speakers

1. Speakers shall be UL 1480 listed, meet all specifications of the Life Safety Code and be capable of reproducing both tone alerts and voice communication instructions. Speakers shall have built in matching transformer, field selectable multiple power taps and circuitry for speaker/line supervision. Speakers shall be provided with screw terminal connection points.
2. Speakers shall be 4" square or round with textured white decorative grill. Speakers shall be tapped to produce a minimum sound-pressure level of 87 dBA at 10 feet. Speakers shall be ceiling mounted.

J. Speakers with Integral Visual Signal

1. Speakers shall be UL 1480 listed, meet all specifications of the Life Safety Code and be capable of reproducing both tone alerts and voice communication instructions. Speakers/strobe units shall be System Sensor L Series of equal by Wheelock. Speakers shall have built in matching transformer, field selectable multiple power taps and circuitry for speaker/line supervision. Speakers shall be provided with screw terminal connection points. Speaker/Strobes shall be white. Each speaker/strobe shall be equipped with an integral high intensity visual alarms shall be Xenon strobe type producing a minimum of 15 candela on a 24 VDC limited energy supervised circuit. Each strobe light shall be capable of providing multi candela output. Alarm devices shall be designated to be ceiling mounted. Signals shall operate in unison with audible alarm appliances. High intensity visual signals shall be of solid state low current design and listed to UL 1971. All strobe lights shall be synchronized.

K. High Intensity Visual Signals

1. Provide high intensity visual strobe lights as required by the Americans with Disabilities Act (ADA Standards Public Law 101-336), local codes and NFPA 72, Chapter 6. Strobe lights shall be white.
2. High intensity visual alarms shall be Xenon strobe type producing a minimum of 15 candela on a 24 VDC limited energy supervised circuit. Each strobe light shall be capable of providing multi candela output. Alarm devices shall be ceiling mounted. Signals shall operate in unison with audible alarm appliances. High intensity visual signals shall be of solid state low current design and listed to UL 1971. All strobe lights shall be synchronized.

L. Exterior Audio-Visual Devices

1. All audio-visual devices located outside or labeled weatherproof shall be weatherproof.
2. All devices shall be provided with a weatherproof type back box.

M. Sprinkler Waterflow Switch

1. Sprinkler waterflow switches shall be installed where indicated on the drawings. Each unit shall contain one set of SPDT alarm contacts. Waterflow switches shall be provided and installed by the fire protection contractor and connected by the fire alarm contractor.

N. Sprinkler Valve Supervisory Switch

1. Sprinkler valve supervisory switches shall be installed on each valve. Each unit shall contain on set of SPDT contacts. Sprinkler valve supervisory switches shall be provided, installed, and adjusted by the fire protection contractor, and connected by the fire alarm contractor.

O. Auxiliary Air Handling Unit (AHU) Relays

1. Provide relays for HVAC and AHU control and interface. Relays shall be heavy duty type and rated up to 10 amps at 24 VDC, 60 HZ. Relays shall be provided with NEMA I dust cover assembly and be provided with SPDT contacts as well as activated LED indicator. All interface relays shall be connected to a supervised notification appliance circuit.

P. Field Charging Power Supplies

1. Provide power supplies with battery backup as required. Electrical Contractor shall provide and install a 120 VAC dedicated circuit to each power supply.

Q. Digital Alarm Transmitter Communicator

1. Provide a four-channel digital communicator to transmit alarm, trouble, supervisory and undefined alarm signals to an approved Central Station. (Telephone lines, Service and Connection by owner). Location to be coordinate with Owner.

R. Protective Covers

1. Provide protective covers on all wall mounted fire alarm devices located on level 1 and level 2 in the new gym addition. These protective covers shall be manufactured by Safety Technology International, Inc. (STI). These covers shall be provided on all devices including but not limited to smoke detectors, heat detectors, audible and visual devices, pull stations, etc. The mounting of a device shall be reinforced to enable the protective covers to protect the fire alarm devices.

PART 3 - EXECUTION

3.1 DESIGN CRITERIA

A. The contractor shall provide drawings for Owner, Engineer, and Fire Marshall's approval.

B. Drawings shall be prepared by a state licensed alarm planning superintendent.

C. Drawings shall comply with all local, state and federal code. These include but are not limited to NEC, UL, NFPA, etc.

D. Provide additional items required above minimum codes include the following:

1. Manual pull stations shall be located not more than 5 feet from the entrance to each exit. Additional manual stations shall be located so that the travel distance to the nearest manual station does not exceed 200 feet. Provide Stopper II covers on all manual pull stations.
2. Manual pull station heights shall be a minimum of 42" and a maximum of 48" measured vertically, from the finished floor level to the activating handle or lever.
3. Smoke Detectors - Paths of egress, electrical rooms, mechanical rooms, MDF, IDF, elevator lobby, storage rooms, top of stairs, elevator machine room, top of elevator shaft, above each fire alarm panel and remote power supplies terminal cabinets. Smoke detectors shall also be provided in each room/area that can be occupied by kindergarten and pre-kindergarten children, which shall include cafeteria, gymnasiums, daycares, libraries, classrooms, and similar areas. Provide a VESDA air sampling smoke detection system in paths of egress where ceiling heights exceed 18 feet.
4. Duct type smoke detectors – all air handling units over 2,000 CFM in duct work or return air paths.
5. Heat Detectors - Shops, kitchens, coffee bars, central plants, boiler room, garages, truck bays and other non-conditioned areas when detection is required.
6. Flow switches - Sprinkler riser.
7. Speakers - throughout the building.
8. Strobes - throughout the building.
9. Remote Power supplies: Locate in mechanical rooms, electrical rooms, MDF or other areas approved by Owner.
10. Smoke Detectors with low frequency sounder bases inside and outside all sleeping rooms. Do not locate over bed.

3.2 INSTALLATION

A. Wiring:

1. All wiring shall be in accordance with NFPA 72 and NFPA 70. All wiring sizes shall conform to recommendations of the equipment manufacturer, and as indicated on the engineered shop drawings.
2. All wire shall be plenum rated, U.L. Listed, limited energy (300 volt) FPLP or MPP wire and shall be run open in return air ceiling plenums. The wire shall comply with NFPA 262 for such applications, shall be of the low smoke producing fluorocarbon type and shall comply with NEC Article 760 if so, approved by the local authority having jurisdiction. Provide conduit in all inaccessible locations, inside concealed wall, all mechanical/electrical rooms, or other areas where wiring might be exposed and subject to damage.
3. Support wire clear of knock out panels, access panels, and maintenance spaces for equipment. Wire and cable shall be run using wire management techniques supporting cable as close as possible to within one foot of the floor or roof rafters. Wire supports shall be directly fastened to the structure on a maximum of five-foot centers. Wire routing shall

be parallel and perpendicular to building lines. The wire and cable shall be secured with tie wraps or carrier wire. Sagging in excess of three inches will not be allowed nor will bending of the supporting ring structure.

4. All wiring for SLC signaling circuits shall be of the twisted low capacitance type to guard against outside RF and EMF interference and induced noise.
5. All wiring shall be run in a supervised fashion (i.e., no branch wiring or dog-legged wiring) per NFPA requirements such that any wiring disarrangement will initiate the appropriate trouble signals via the main control panel per NFPA.
6. Wiring splices shall be kept to a minimum with required splices to be made in designated terminal boxes or at field device junction boxes. Transposing or color code changes of wiring will not be permitted. End-of-line supervisory devices shall be installed with the last device on the respective circuit. Devices shall be appropriately marked designating it as the terminating device on the respective circuit.
7. No A.C. wiring or any other wiring shall be run in the same conduit as fire alarm wiring.
8. All insulation on conductors shall be RED with traces to identify circuits.

B. Open Wiring

1. Systems utilizing open wiring techniques shall use low smoke plenum cable.
2. Support wire clear of knock out panels access panels and maintenance spaces for equipment. Wire and cable shall be run using wire management techniques supporting cable as close as possible to within one foot of the floor or roof rafters. Wire supports shall be directly fastened to the structure on a maximum of five foot on centers. Wire routing shall be parallel and perpendicular to building lines. The wire and cable shall be secured with tie wraps or carrier wire. Sagging in excess of three inches will not be allowed nor will bending of the supporting ring structure.
3. Provide Caddy J-hooks supported independently from other system to support cable at 4-foot on center or closer if required by manufacturer.
4. Provide a junction box to make up all joints and splices.
5. Provide cable supports in all vertical raceways in accordance with Article 300-19 of NFPA 70.

C. 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 in division 26 specifications and per National Electrical Code.
3. Minimum conduit size shall be 3/4" EMT. Install conduit per engineered shop drawings.
4. All wiring in mechanical rooms, electrical rooms, drywall ceiling, inaccessible areas, underground, plaster ceiling, inside concealed walls areas exposed to occupant view, and other areas subject to physical damage shall be run in conduit.
5. Sleeves shall be placed in the forms of concrete, masonry and fire rated walls, floor slabs and beams for the passage of wiring. Sleeves should be set in place a sufficient time ahead of the concrete work so as not to delay the work. Sleeves shall be rigid galvanized steel.

D. Minimum Wire Sizes Shall Be As Follows:

1. Signaling Line Circuit: 18 AWG

2. Notification Appliance Circuit: 14 AWG
3. Relay Control Circuits: 18 AWG

E. 120 VAC Power wiring

1. Contractor shall provide all required dedicated 20 amp, 120 VAC power circuits for the fire alarm system including but not limited to the main fire alarm panel, remote amplifier panels, and remote strobe light power supplies. Connect to emergency power when available in the building.

F. Minimum Wire Sizes Shall Be As Follows:

1. Signaling Line Circuit: 18 AWG
2. Notification Appliance Circuit: 14 AWG
3. Relay Control Circuits: 18 AWG

G. Sprinkler Valves

1. Contractor shall connect all tamper switches and post indicator valves to the supervisory circuit. Connect all water flow switches to the alarm circuit. Coordinate exact locations of water vaults valves and flow switches with sprinkler contractor.

3.3 NOTIFICATION APPLIANCE CIRCUITS SYNCHRONIZATION

A. All visual and audible devices shall be synchronized per the current state adopted version of NFPA 72. Provide all components required.

3.4 SMOKE AND COMBINATION FIRE SMOKE DAMPERS

A. Provide duct type smoke detectors in ductwork downstream of each smoke damper and fire smoke damper. Locate within 5 feet on the damper. Provide a remote smoke detector reset device. Provide access panel when not located above an accessible ceiling. Interlock with HVAC unit serving the ductwork to shut down.

3.5 MISCELLANEOUS SYSTEMS

A. Monitor all fire suppression systems, carbon monoxide system panels and refrigerant system control panels.

3.6 TEST AND REPORTS

A. A state licensed and factory trained technical representative of the manufacturer 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. Instruction shall be 4 hours minimum.

B. The installing contractor shall functionally test each and every device in the entire system for proper operation and response. In addition, each circuit in the system shall be fully tested for wiring supervision. Any items found not properly installed or non-functioning shall be replaced or repaired and re-tested.

C. The installing contractor shall provide a complete written report on the functional test of the entire system. A copy of the test report shall be provided with maintenance manuals. The test report shall be signed and dated by the licensed fire alarm superintendent responsible for supervising the final system test and checkout.

D. 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.

E. It is the intent of these specifications and of the architect/engineer that a continued program of system maintenance be continued by the owner in compliance with NFPA 72, Chapter 7. It is mandatory that the installing contractor shall provide such services and make available these services to the owner upon completion of the project.

3.7 WARRANTY

A. The fire alarm system, 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 acceptance or beneficial occupancy, whichever shall occur first. Any equipment or workmanship shown to be defective shall be repaired, replaced, or adjusted during normal working hours at no cost to the owner.

B. 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.

3.8 GRAPHIC FLOOR PLANS

A. Provide (2) 1/16" = 1'-0" floor plan on each floor showing all devices and zoning. Zoning shall correspond to the zone on the fire alarm control panel and remote annunciator. The floor plans shall be framed with a glass cover and located by the fire alarm control panel and by each remote annunciator. Provide a sample for approval.

3.9 SPARE PARTS AND ATTIC STOCK

A. Provide 5% spare field devices including labor to install them. Devices not used shall be given to the Owner at time of job completion.

B. The fire alarm contractor shall include in his bid the cost to provide and install the additional spare parts and attic stock and associated cabling. All devices not used during construction shall be turned over to the owner at the time of job completion

END OF SECTION 284609

SECTION 284609.01 - FIRE ALARM SYSTEM WITH VOICE EVACUATION WITH ALTERNATE

PART 1 - GENERAL

1.1 SCOPE

A. The contractor shall provide a new completely distributed microprocessor based 24VDC, electrically supervised, MULTIPLEX, integrated fire alarm with voice evacuation system as specified and required by applicable codes and remove the old fire alarm system. The new system shall include, but not be limited to, all control equipment, remote transponders, printer, power supplies, signal initiating and signaling devices, conduit, wire, fittings, and all other accessories required to provide a complete and operable system. The existing fire alarm system shall remain operational until new fire alarm system is fully functional and commissioned.

B. All equipment, materials, accessories, devices, etc. covered by the specifications shall be new and unused and shall be U.L. listed for their intended use.

C. The system shall operate as a non-coded, continuous sounding system which will sound alarm devices until manually silenced, as herein specified.

D. The system shall be wired as a Class B supervised system for all circuits.

1.2 REFERENCE STANDARDS

A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.

B. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

D. NFPA 72 - National Fire Alarm and Signaling Code; Most Recent Edition Cited by Referring Code or Reference Standard.

E. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2024.

F. NFPA 101 - Life Safety Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

G. NFPA 262 - Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces; Current Edition, Including All Revisions.

H. UL 38 - Standard for Manual Signaling Boxes for Fire Alarm Systems; Current Edition, Including All Revisions.

I. UL 228 - Safety Door Closers-Holders, with or without Integral Smoke Detectors; 2008.

J. UL 268 - Standard for Smoke Detectors for Fire Alarm Systems; Current Edition, Including All Revisions.

K. UL 268A - Standard for Smoke Detectors for Duct Application; Current Edition, Including All Revisions.

L. UL 464 - Standard for Audible Signaling Devices for Fire Alarm and Signaling Systems, Including Accessories; Current Edition, Including All Revisions.

M. UL 521 - Standard for Heat Detectors for Fire Protective Signaling Systems; Current Edition, Including All Revisions.

N. UL 864 - Control Units and Accessories for Fire Alarm Systems; Current Edition, Including All Revisions.

O. UL 1638 - Standard for Visible Signaling Devices for Fire Alarm and Signaling Systems, Including Accessories; Current Edition, Including All Revisions.

P. UL 1971 - Standard for Signaling Devices for the Hearing Impaired; Current Edition, Including All Revisions.

Q. UL 2034 - Standard for Single and Multiple Station Carbon Monoxide Alarms; Current Edition, Including All Revisions.

R. UL 2075 - Standard for Gas and Vapor Detectors and Sensors; Current Edition, Including All Revisions.

1.3 INSTALLING CONTRACTOR'S RESPONSIBILITY

A. The installing fire alarm contractor is responsible for the design of a code compliant system, which meets the intent of all State and Local Authority Having Jurisdiction Codes and their adopted amendments along all permitting of such plans and associated permit fees. Reference and coordinate with all contract specifications and plans.

1.4 ACCEPTABLE MANUFACTURERS

A. Provide one of the following manufacturers:

1. ALTERNATE 7A - Edwards System Technology (EST 4) by Wilson Fire
2. ALTERNATE 7B - Siemens by Fire-Safe
3. ALTERNATE 7C - Notifier by Fire-Tron

B. Alternate Manufacturers

1. Equipment from other manufacturer's or supplier's may be considered as an equal to that specified provided that completely marked and identified catalog sheets of all proposed equipment is provided to the architect/engineer for review ten (10) days prior to the date of bid for evaluation. In addition, a list of the contractor's qualifications and any exceptions

to the specifications must be provided for review. Approval for any such substitution of equipment must be obtained in writing from the architect/engineer for five (5) days prior to bid.

1.5 GENERAL REQUIREMENTS

A. Contractor Qualifications:

1. The equipment supplier shall be an authorized and designated representative of the Fire Alarm Manufacturer to sell, install, and service the proposed manufacturer's equipment.
2. The equipment supplier and installing contractor shall be licensed by the State Fire Marshal to sell, install, and service fire alarm systems as required by State Insurance Code.
3. The installing contractor and/or equipment supplier shall have on his staff a minimum of three (3) installation superintendents who are licensed by the State Fire Marshall's office for such purpose and under whose supervision installation, final connections, and check out will take place as required by the State Insurance Code.
4. The installing contractor or equipment supplier shall have on staff a minimum of one (1) certified NICET Level III state licensed fire alarm planner under whose supervision system design shall take place.
5. The installing contractor shall provide 24-hour, 365 days per year emergency service with qualified and state licensed service technicians.
6. The installing contractor shall have been actively engaged in the business of selling, installing, and servicing fire alarm systems for at least ten (10) years.

1.6 SUBMITTALS

A. The installing contractor and/or equipment manufacturer shall provide complete and detailed shop drawings and include:

1. Control panel configuration including wiring and interconnection schematics.
2. Complete point to point wiring diagram showing terminal connections to all system devices.
3. Riser wiring diagram and associated zoning/addressing configurations with associated conduit sizes.
4. Complete floor plan drawings locating all devices associated with the fire alarm system. Floor plan drawings shall include conduit and wiring routing complete with conduit sizing and number of conductors by type. Floor plans shall be on AutoCAD v.12.
5. Factory data sheets on each piece of equipment to be used and so marked as to model, dimensions, size, voltage, and configuration.
6. Detailed system description in this specification format describing system functions and operation. All specification variations and deviations shall be clearly noted and marked.
7. Complete Bill of Material for reference.
8. Programming matrix defining all input/output functions and zoning.
9. Power supply and battery calculations.
10. A written certification from the manufacturer stating that the distributor is authorized to sell, service and install the proposed fire alarm system.

B. Submittal shall include documentation confirming all qualifications have been met. Submittals without qualification documentation shall be returned "Revise and Resubmit".

C. All submittal data will be in bound form with contractor's name, supplier's name, project name, and state fire alarm license number adequately identified.

1.7 COORDINATION

A. It shall be the responsibility of the installing contractor to coordinate all requirements surrounding installation of the fire alarm system with all trades including, but not exclusive of elevator, electrical contractor, sprinkler contractor, and HVAC/controls contractor and intercom system. Adequate coordination shall be provided to insure proper installation and interface to all peripheral items required to interact with the fire alarm and communication system to provide a complete and functional life safety system.

PART 2 - PRODUCTS

2.1 SYSTEM FUNCTIONAL OPERATION

A. ALARM DETECTION

1. When a fire alarm condition is detected via the main fire control panel by any of the system alarm initiating devices, the following functions shall occur:

a. The system common alarm LED on the CPU Module shall flash. The internal audible trouble device shall sound Acknowledging the alarm condition shall silence the audible trouble device and revert the flashing common alarm LEDs to a steady state
b. A multi-character back-lit LCD Display shall indicate all applicable information associated with the alarm condition including zone, device type, device location, and time of alarm Location and zoning messages shall be custom field programmed to respective premises
c. Any remote annunciator LCD display associated with the alarm zone shall be activated as herein specified
d. All automatic events programmed to the alarm point shall be executed and the associated indicating devices and/or outputs activated
e. Alarm tones shall sound throughout the facility. Upon expiration of the alert tone, a digitized predetermined voice evacuation message shall be automatically transmitted throughout the facility The system shall have the capability to generate multiple distinct digital messages as determined by event-initiated programs
f. Activate all visual alarm notification devices throughout the facility
g. Recall elevators to ground floor as specified herein, or to the alternate floor if the alarm condition originates on the ground floor
h. Unlock all electrically locked doors
i. De-activate HVAC systems over 2,000 cfm
j. Release all smoke doors, fire doors, fire coiling doors, fire smoke dampers and fire shutters.

k. Activate the smoke control system for the atrium

B. System Trouble Detection

1. When a trouble condition is detected by the CPU, one of the system initiating, alarm or SLC circuits, the following functions shall immediately occur:

a. The system trouble LED on the CPU module shall flash and the internal audible trouble device shall sound. Acknowledgment of the trouble condition shall silence the audible trouble device and cause all trouble LEDs to illuminate steady.
b. The multi-character alphanumeric LCD annunciator shall display all applicable information via the alphanumeric display associated with the respective trouble condition and its location.
c. The system common trouble indicator on associated remote annunciators shall be illuminated as specified herein.

C. Auxiliary Control

1. All designated "non-silenceable" auxiliary control functions shall remain in operation (even upon silencing of audible alarms) until such time as the control panel is cleared and reset manually (i.e., fan control outputs, central station interface, elevator recall interface, etc.).
2. Activation of duct smoke detectors associated fans shall shutdown their respective units immediately in addition to identifying the condition as herein specified. Duct detectors shall be programmed as a supervisory condition per NFPA 72.

D. System Supervisory Detection

1. When a supervisory condition is detected by the fire alarm control panel, the following functions shall occur:

a. The fire alarm control panel supervisory indicator shall flash, and the internal audible device shall sound Acknowledgment of the supervisory condition shall silence the audible device and cause the supervisory indicator to illuminate steady
b. The multi-character liquid crystal display shall display all applicable information associated with the respective supervisory condition.
c. Display the system status change on the remote annunciators

E. Remote Off-site Monitoring

1. The remote off-site monitoring system shall transmit point specific alarm, trouble, and supervisory signals to an Approved Central Supervising Station (Central Station connection, phone lines or cellular connectivity service provided by Owner).

F. Fire Drill Control

1. Provide a fire drill switch located on the Fire Alarm Control Panel. When activated, this switch will activate all horns and visual devices (strobes) for a fire drill. It shall not release fire shutter, shut down air handling equipment or recall elevators. If a fire alarm condition is detected, the system shall operate as defined in part A - "Alarm Detection" of this section.

2.2 ZONING

A. The system shall have the inherent capability to employ "Intelligent" smoke detectors and addressable interface devices capable of being recognized and annunciated at the main control panel on an individual basis. All zoning/device location information shall be totally field programmable to exact job requirements as approved by the architect/engineer.

B. The system shall utilize remote amplifier cabinets for distributed voice communications (if needed), notification appliance circuits, and auxiliary control output circuits. Remote transponder panels shall communicate with the main CPU via the SLC data loop and be capable of being intermixed on the same loop as intelligent smoke detection and control modules.

2.3 FIRE ALARM CONTROL PANEL

A. The fire alarm control panel shall be provided with adequate number of SLC points to the building plus 50% spare. The control panel shall be modular in design utilizing DISTRIBUTED solid-state MICROPROCESSORS and be capable of future expansion. The microprocessor-based CPU shall be completely FIELD PROGRAMMABLE. CPU module shall provide for programmable non-volatile RAM memory utilizing integral lithium based memory IC chips. All circuitry shall be U.L. listed for power-limited application. System shall be capable of being networked for future expansion.

B. Portable Buildings

1. Provide a minimum of (50) fifty initiating points for future portable buildings. Provide (2) dedicated NAC circuits pulled to the exit point above the ceiling. Refer to floor plan for location.

C. Central Processing Unit Module (CPU)

1. The CPU shall contain and execute all custom time control functions or control-by-event programs for specified events including 'Holiday' exceptions. Time control events/programs shall be automatically overridden by priority fire alarm events. All programs shall be held in non-volatile programmable memory and shall not be lost even if both system primary and secondary power failure occurs.
2. System CPU shall also provide for non-alarm points for non-fire, low priority building functions. The CPU shall provide capability of multi-stage signaling, tornado warning, emergency radio communication enhancement system, positive alarm sequencing as well as remote control system operation.

D. Display Interface Board (DIA)

1. The DIA shall provide a multi-character back-lit, super-twist Liquid Crystal Display (LCD). It shall provide Light-Emitting Diodes (LED's) for AC POWER; SYSTEM ALARM; SYSTEM TROUBLE; DISPLAY TROUBLE; and DISABLE.
2. The DIA shall provide a 25-key membrane keypad with control capability to command all system functions, status readouts, manual control action, and entry of any alphabetic or numeric information. The keypad shall include means to enter multiple five-digit passwords to prevent unauthorized manual control or programming.

E. Control Switches

1. Acknowledge/step Switch
2. Signal Silence Switch
3. System Reset Switch
4. System Test Switch
5. Lamp Test

F. System Outputs

1. The system shall provide the following outputs:

a. One port for laptop and/or modem
b. One port for supervised remote LCD annunciators (RS-485)

G. Loop Interface (SLC)

1. The CPU shall communicate and provide power to all devices on its loop over a single pair of wires. The CPU shall receive digital/ANALOG information from all "intelligent" detectors and shall process this information to determine normal, alarm, trouble, and sensitivity conditions. The analog information may be used for automatic test and determination of maintenance requirements and be U.L. listed for such use. The CPU module shall individually monitor all "intelligent" detectors for sensitivity variation initiating a trouble condition should detector sensitivity "drift" become excessive. The system control unit shall have the capability to remotely read each detector's sensitivity in % obscuration, and if need be, electronically adjust the detector sensitivity as required for existing conditions within U.L. recommended limits. In addition, the system shall incorporate a "day/night" sensitivity feature. The system shall provide capability to program each individual detector for multiple 'pre-alarm' conditions. Each 'pre-alarm' level shall be field programmable as a function of the programmed alarm level. The system shall allow designated control-by-event actions to occur as may be required prior to any sensor reaching the designated alarm point.

H. Non-Lock Walk Test

1. The system shall include a special non-lock "walk test" mode. The walk test mode shall incorporate a time-out feature to return system to normal. Test results shall be capable of being generated and displayed on the LCD annunciator.

I. Automatic Detector Test

1. The system shall include a special automatic detector test feature which permits reading and adjustment of the sensitivity of all intelligent detectors from the main control panel. In addition, the automatic test feature shall also permit the functional testing of any "intelligent" detector or addressable interface device individually from the main control panel. An automatic detector test shall occur automatically fourteen times each twenty-four-hour period or be initiated manually from the FACP as desired. Automatic detector test sequencing shall be terminated upon receipt of a true alarm condition.

J. Special System Reports

1. The system shall have the ability to generate and print, upon command, system and point status reports. Selection of 'system' read status provides the operator with global system programming information. Selection of 'point' read status provides the operator with selected individual point programming data. The system shall also provide the capability to print out a detailed 'history' report from system history file upon command.

K. Field Programming

1. The system shall be 100% field programmable without the need for external computers or PROM programmers and shall NOT require replacement of memory IC's. Systems requiring factory programming/re-programming OR REPLACEMENT OF MEMORY I.C. CHIPS shall not be acceptable. All programs shall be stored in non-volatile RAM memory. Programming shall be accomplished only after entering an appropriate and pre-selected five-digit password security code. System programming mode shall not require the system to be taken off-line nor prohibit the system from performing its normal operations and routines. The system shall be capable of revising/changing programmed functions or system expansion at any time subsequent to initialization as described herein without factory modifications or factory programming. Field programming via the use of external computers may be considered provided programming can be accomplished on-site and the owner permanently furnished with required programming apparatus and software as part of this contract.

L. Event History

1. The main fire alarm panel shall have the resident ability to store a minimum of 600 system events in chronological order of occurrence. Event history shall include all system alarms, troubles, operator actions, unverified alarms, circuit/point alterations, and component failures. Events shall be time and date stamped. Events shall be stored in non-volatile buffer memory. Access to history buffer shall be secured via five-digit password security code.

M. Power Supply

1. The power supply shall provide all control panel and peripheral power needs with filtered power as well as regulated 24VDC power for external audio-visual devices. The audio-visual power may be increased as needed by adding additional modular expansion power supplies. All power supplies shall be designed to meet U.L. and NFPA requirements for POWER-LIMITED operation on all external signaling lines, including initiating circuits and indicating circuits.
2. Input power shall be 120VAC 60Hz. The power supply shall provide internal supervised batteries and automatic charger. The power supply shall provide both positive and negative ground fault supervision, battery/charger fail condition, A.C. power fail indicators. The power supply shall also provide supervision of modular expansion power supplies as may be required.
3. Batteries shall have 24 hours of standby capacity and 15 minutes of alarm capacity. Battery charger shall recharge batteries from full discharge to full charge over a 24-hour period. Switching from normal power to battery power and back shall occur automatically.

2.4 VOICE COMMUNICATIONS

A. The voice communications panel shall be modular in design utilizing solid state MICROPROCESSOR circuitry. The voice evacuation system shall integrate with the main fire alarm control panel. Side car voice evacuation systems are not acceptable.

B. Communications Controls: The communications control panel shall incorporate the following controls and indicators:

1. All call
2. General alarm
3. Audio trouble LED
4. AUDIO LEVEL LED
5. Manual tone/MESSAGE select switches with LED indicators
6. Communications zone select switches and select indicators
7. Communications monitor speaker with volume control
8. Dynamic paging microphone

C. Paging

1. The microprocessor based one way paging system shall be provided with a means to selectively activate voice, tones, or digitized messages to any or all zones in the system via electronic membrane touch-pad controls. In addition, visual indication by zone will be provided.
2. Each audio/speaker circuit will be totally supervised for opens, shorts or grounds with direct shorts prohibiting selection of the respective zone. All audio circuits shall be POWER LIMITED. Each speaker zone shall be provided with an amber trouble LED for circuit trouble conditions and an active/on LED indicator.
3. Alarm/Paging zones shall be provided as required.

D. Alarm Electronics

1. The voice communications center shall be a microprocessor based, supervised, multi-function, audio generator. The communications generator shall contain:

    a. Independent Voice communications CPU b Non-volatile RAM memory
    b. One custom digitized message circuits
    c. Up to four selectable tone generator/oscillators
    d. Each sub-circuit of the communications center shall be fully supervised and failure of any tone oscillator or digital message generator shall revert the system to the default standby generator

2. The system shall be provided with a custom field programmable digitized message.
3. The system shall provide adequate audio amplification. The system shall be capable of amplifier capacity and expansion as required. Each amplifier shall be continuously monitored electronically for proper output level. Each unit shall be equipped with diagnostic indicators. Each amplifier shall provide a minimum of 50 watts of 25 VRMS of power. Each unit shall be equipped with its own individual power/pilot LED, audio input trouble LED, battery input trouble LED, and amplifier trouble/fail LED. Provide amplification for 1/2 watt per speaker plus 25% spare capacity. Electrical Contractor shall

provide and install a 120 VAC dedicated circuit to each remote amplifier cabinet (if needed).

2.5 FIELD DEVICES

A. Multi Criteria Smoke Heat and Infrared Detector:

1. Provide intelligent multi criteria detector. The intelligent multi criteria detector shall be an addressable device that is designed to monitor a minimum of photoelectric and thermal technologies in a single sensing device. The design shall include the ability to adapt to its environment by utilizing a built-in microprocessor to determine its environment and choose the appropriate sensing settings. The detector design shall allow a wide sensitivity window, no less than 1 to 4% per foot obscuration. This detector shall utilize advanced electronics that react to slow smoldering fires and thermal properties all within a single sensing device.
2. The microprocessor design shall be capable of selecting the appropriate sensitivity levels based on the environment type it is in (office, manufacturing, kitchen etc.) and then have the ability to automatically change the setting as the environment changes (as walls are moved or as the occupancy changes).
3. 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.
4. The detector shall be semi-flush ceiling mounted and be provided with modular detector head with twist-lock base.

B. Intelligent Duct Detector

1. Provide duct mounted "intelligent" photoelectric smoke detectors. Detectors shall operate on the same principles and exhibit the same basic characteristics as area type "intelligent" photoelectric smoke sensors. The unit shall be capable of interchanging/accepting either photo-electronic or ionization type 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.
2. The unit shall consist of a clear molded plastic enclosure with integral conduit knockouts. The unit shall be provided with clear faceplate cover 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. Detectors shall be installed per NFPA 90A and be listed with the fire alarm control panel. A remote LED shall be located on the corridor ceiling adjacent to the respective detector where detectors are not plainly visible or concealed from view.

C. Intelligent Thermal Detectors

1. Provide analog, fixed temperature, thermal detectors. The detectors shall use dual electronic thermostats to measure temperature levels in the chamber and shall, on command from the control panel, send data to the panel representing the analog temperature level.
2. The detectors shall provide dual alarm and power/status LED's. Status LEDs shall flash under normal conditions, indicating that the detector is operational and in regular communication with the control panel. Both LED's may be placed into steady illumination by the control panel, indicating that an alarm condition has been detected. An output connection shall also be provided in the base to connect an external remote alarm LED.
3. The detector shall be semi-flush ceiling mounted and be provided with modular detector head with twist-lock base.

D. Conventional Weatherproof Thermal Detector

1. Provide when heat detection devices are located in harsh and/or moist environments, such as showers and similar areas, which are subject to high humidity, the following device shall be provided. Weatherproof Heat Detector 135°F Rate Compensated shall be provided. The detector shall mount in a weatherproof 4" electrical box with 1/2" NPT threaded hub. This detector shall be connected to an addressable monitor module.

E. Addressable Manual Stations

1. Provide Manual stations.

    a. The manual stations shall contain the intelligence for reporting address, identity, alarm, and trouble to the fire alarm control panel
    b. The manual pull station shall be constructed of durable molded polycarbonate material and shall be RED in color with raised white lettering Stations shall be of the dual action type
    c. All manual pull stations shall be provided with an STI-1100 series clear plastic cover with integral horn.

F. Monitor Module

1. Provide 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.

G. Control Module

1. Provide control/relay modules 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 using rotary decimal switches. No binary coding shall be required. A status LED shall be provided which shall flash under normal conditions, indicating that the control module is operational and in regular communication with the control panel. The LED shall illuminate steadily when the device is actuated via the fire alarm control panel.

H. Remote LCD Alpha-Numeric Annunciators with Remote Microphone and Switches

1. Provide a multi-character remote LCD alpha-numeric annunciator or approved equal to annunciate all system events and duplicate the displayed status at the main FACP. The annunciator shall be a backlit eighty-character LCD display and operate via the system RS485 or RS232 serial output terminal from the main FACP. The LCD display shall automatically illuminate upon receipt of an alarm or trouble condition. The illumination source shall extinguish during normal/standby mode to conserve power. The unit shall operate from FACP 24VDC power and function during system power failure while the system resides on standby batteries. The remote LCD annunciator shall include:

    a. Integral time-date clock
    b. Time-date select switch
    c. Time-date/contrast adjust
    d. Display/step switch
    e. System reset
    f. System silence
    g. System acknowledge
    h. Integral trouble buzzer
    i. Point enable/disable capability
    j. Full QWERTY keypad for system programming

2. Annunciator shall upon command display the first system alarm, last alarm, and system alarm count. The unit shall be equipped with an integral lamp test feature. The unit shall be semi flush mounted where shown.
3. Provide enclosure with a remote microphone with selector switches.

I. Speakers

1. Speakers shall be UL 1480 listed, meet all specifications of the Life Safety Code and be capable of reproducing both tone alerts and voice communication instructions. Speakers shall have built in matching transformer, field selectable multiple power taps and circuitry for speaker/line supervision. Speakers shall be provided with screw terminal connection points.
2. Speakers shall be 4" square or round with textured white decorative grill. Speakers shall be tapped to produce a minimum sound-pressure level of 87 dBA at 10 feet. Speakers shall be ceiling mounted.

J. Speakers with Integral Visual Signal

1. Speakers shall be UL 1480 listed, meet all specifications of the Life Safety Code and be capable of reproducing both tone alerts and voice communication instructions. Speakers/strobe units shall be System Sensor L Series of equal by Wheelock. Speakers shall have built in matching transformer, field selectable multiple power taps and circuitry for speaker/line supervision. Speakers shall be provided with screw terminal connection points. Speaker/Strobes shall be white. Each speaker/strobe shall be equipped with an integral high intensity visual alarms shall be Xenon strobe type producing a minimum of 15 candela on a 24 VDC limited energy supervised circuit. Each strobe light shall be capable of providing multi candela output. Alarm devices shall be designated to be ceiling mounted. Signals shall operate in unison with audible alarm appliances. High intensity

visual signals shall be of solid state low current design and listed to UL 1971. All strobe lights shall be synchronized.

K. High Intensity Visual Signals

1. Provide high intensity visual strobe lights as required by the Americans with Disabilities Act (ADA Standards Public Law 101-336), local codes and NFPA 72, Chapter 6. Strobe lights shall be white.
2. High intensity visual alarms shall be Xenon strobe type producing a minimum of 15 candela on a 24 VDC limited energy supervised circuit. Each strobe light shall be capable of providing multi candela output. Alarm devices shall be ceiling mounted. Signals shall operate in unison with audible alarm appliances. High intensity visual signals shall be of solid state low current design and listed to UL 1971. All strobe lights shall be synchronized.

L. Exterior Audio-Visual Devices

1. All audio-visual devices located outside or labeled weatherproof shall be weatherproof.
2. All devices shall be provided with a weatherproof type backbox.

M. Sprinkler Waterflow Switch

1. Sprinkler waterflow switches shall be installed where indicated on the drawings. Each unit shall contain one set of SPDT alarm contacts. Waterflow switches shall be provided and installed by the fire protection contractor and connected by the fire alarm contractor.

N. Sprinkler Valve Supervisory Switch

1. Sprinkler valve supervisory switches shall be installed on each valve. Each unit shall contain on set of SPDT contacts. Sprinkler valve supervisory switches shall be provided, installed, and adjusted by the fire protection contractor, and connected by the fire alarm contractor.

O. Auxiliary Air Handling Unit (AHU) Relays

1. Provide relays for HVAC and AHU control and interface. Relays shall be heavy duty type and rated up to 10 amps at 24 VDC, 60 HZ. Relays shall be provided with NEMA I dust cover assembly and be provided with SPDT contacts as well as activated LED indicator. All interface relays shall be connected to a supervised notification appliance circuit.

P. Field Charging Power Supplies

1. Provide power supplies with battery backup as required. Electrical Contractor shall provide and install a 120 VAC dedicated circuit to each power supply.

Q. Digital Alarm Transmitter Communicator

1. Provide a four-channel digital communicator to transmit alarm, trouble, supervisory and undefined alarm signals to an approved Central Station. (Telephone lines, Service and Connection by owner). Location to be coordinate with Owner.

R. Protective Covers

1. Provide protective covers on all wall mounted fire alarm devices located in student restrooms, corridors and in the cafeteria. These protective covers shall be manufactured by Safety Technology International, Inc. (STI). These covers shall be provided on all devices including but not limited to smoke detectors, heat detectors, audible and visual devices, pull stations, etc. The mounting of a device shall be reinforced to enable the protective covers to protect the fire alarm devices.

PART 3 - EXECUTION

3.1 DESIGN CRITERIA

A. The contractor shall provide drawings for Owner, Engineer, and Fire Marshall's approval.

B. Drawings shall be prepared by a state licensed alarm planning superintendent.

C. Drawings shall comply with all local, state, and federal code. These include but are not limited to NEC, UL, NFPA, etc.

D. Locate the fire alarm control panel in the MDF unless otherwise directed by Owner.

E. Locate a remote annunciator with remote microphone in the main office unless otherwise directed by Owner.

F. Provide additional items required above minimum codes include the following:

1. Manual pull stations shall be located not more than 5 feet from the entrance to each exit. Additional manual stations shall be located so that the travel distance to the nearest manual station does not exceed 200 feet. Provide Stopper II covers on all manual pull stations
2. Manual pull station heights shall be a minimum of 42" and a maximum of 48" measured vertically, from the finished floor level to the activating handle or lever.
3. Smoke Detectors - Paths of egress, electrical rooms, mechanical rooms, MDF, IDF, elevator lobby, storage rooms, top of stairs, elevator machine room, top of elevator shaft, above each fire alarm panel and remote power supplies terminal cabinets. Smoke detectors shall also be provided in each room/area that can be occupied by kindergarten and pre-kindergarten children, which shall include cafeteria, gymnasiums, daycares, libraries, classrooms, nurse's patient areas and similar areas. Provide a VESDA air sampling smoke detection system in paths of egress where ceiling heights exceed 18 feet.
4. Duct type smoke detectors – all air handling units over 2,000 CFM in duct work or return air paths.
5. Heat Detectors - Shops, kitchens, coffee bars, central plants, boiler room, garages, truck bays and other non-conditioned areas when detection is required.
6. Flow switches - Sprinkler riser.
7. Speakers - throughout the building.
8. Strobes - throughout the building.
9. Remote Power supplies: Locate in mechanical rooms, electrical rooms, MDF or other areas approved by Owner.

10. Smoke Detectors with low frequency sounder bases inside and outside all sleeping rooms. Do not locate over bed.

3.2 INSTALLATION

A. Wiring:

1. All wiring shall be in accordance with NFPA 72 and NFPA 70. All wiring sizes shall conform to recommendations of the equipment manufacturer, and as indicated on the engineered shop drawings.
2. All wire shall be plenum rated, U.L. Listed, limited energy (300 volt) FPLP or MPP wire and shall be run open in return air ceiling plenums. The wire shall comply with NFPA 262 for such applications, shall be of the low smoke producing fluorocarbon type and shall comply with NEC Article 760 if so, approved by the local authority having jurisdiction. Provide conduit in all inaccessible locations, inside concealed wall, all mechanical/electrical rooms, or other areas where wiring might be exposed and subject to damage.
3. Support wire clear of knock out panels, access panels, and maintenance spaces for equipment. Wire and cable shall be run using wire management techniques supporting cable as close as possible to within one foot of the floor or roof rafters. Wire supports shall be directly fastened to the structure on a maximum of five-foot centers. Wire routing shall be parallel and perpendicular to building lines. The wire and cable shall be secured with tie wraps or carrier wire. Sagging in excess of three inches will not be allowed nor will bending of the supporting ring structure.
4. All wiring for SLC signaling circuits shall be of the twisted low capacitance type to guard against outside RF and EMF interference and induced noise.
5. All wiring shall be run in a supervised fashion (i.e., no branch wiring or dog-legged wiring) per NFPA requirements such that any wiring disarrangement will initiate the appropriate trouble signals via the main control panel per NFPA.
6. Wiring splices shall be kept to a minimum with required splices to be made in designated terminal boxes or at field device junction boxes. Transposing or color code changes of wiring will not be permitted. End-of-line supervisory devices shall be installed with the last device on the respective circuit. Devices shall be appropriately marked designating it as the terminating device on the respective circuit.
7. No A.C. wiring or any other wiring shall be run in the same conduit as fire alarm wiring.
8. All insulation on conductors shall be RED with traces to identify circuits.

B. Open Wiring

1. Systems utilizing open wiring techniques shall use low smoke plenum cable.
2. Support wire clear of knock out panels access panels and maintenance spaces for equipment. Wire and cable shall be run using wire management techniques supporting cable as close as possible to within one foot of the floor or roof rafters. Wire supports shall be directly fastened to the structure on a maximum of five foot on centers. Wire routing shall be parallel and perpendicular to building lines. The wire and cable shall be secured with tie wraps or carrier wire. Sagging in excess of three inches will not be allowed nor will bending of the supporting ring structure.
3. Provide Caddy J-hooks supported independently from other system to support cable at 4-foot on center or closer if required by manufacturer.

4. Provide a junction box to make up all joints and splices.
5. Provide cable supports in all vertical raceways in accordance with Article 300-19 of NFPA 70.

C. 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 in division 26 specifications and per National Electrical Code.
3. Minimum conduit size shall be 3/4" EMT. Install conduit per engineered shop drawings.
4. All wiring in mechanical rooms, electrical rooms, drywall ceiling, inaccessible areas, underground, plaster ceiling, inside concealed walls areas exposed to occupant view, and other areas subject to physical damage shall be run in conduit.
5. Sleeves shall be placed in the forms of concrete, masonry and fire rated walls, floor slabs and beams for the passage of wiring. Sleeves should be set in place a sufficient time ahead of the concrete work so as not to delay the work. Sleeves shall be rigid galvanized steel.

D. Minimum Wire Sizes Shall Be As Follows:

1. Signaling Line Circuit: 18 AWG
2. Notification Appliance Circuit: 14 AWG
3. Relay Control Circuits: 18 AWG

E. 120 VAC Power wiring

1. Contractor shall provide all required dedicated 20 amp, 120 VAC power circuits for the fire alarm system including but not limited to the main fire alarm panel, remote amplifier panels, and remote strobe light power supplies. Connect to emergency power when available in the building.

F. Minimum Wire Sizes Shall Be As Follows:

1. Signaling Line Circuit: 18 AWG
2. Notification Appliance Circuit: 14 AWG
3. Relay Control Circuits: 18 AWG

G. Sprinkler Valves

1. Contractor shall connect all tamper switches and post indicator valves to the supervisory circuit. Connect all water flow switches to the alarm circuit. Coordinate exact locations of water vaults valves and flow switches with sprinkler contractor.

3.3

3.4 NOTIFICATION APPLIANCE CIRCUITS SYNCHRONIZATION

A. All visual and audible devices shall be synchronized per the current state adopted version of NFPA 72. Provide all components required.

3.5 SMOKE AND COMBINATION FIRE SMOKE DAMPERS

A. Provide duct type smoke detectors in ductwork downstream of each smoke damper and fire smoke damper. Locate within 5 feet on the damper. Provide a remote smoke detector reset device. Provide access panel when not located above an accessible ceiling. Interlock with HVAC unit serving the ductwork to shut down.

3.6 MISCELLANEOUS SYSTEMS

A. Monitor all fire suppression systems, carbon monoxide system panels and refrigerant system control panels.

3.7 TEST AND REPORTS

A. A state licensed and factory trained technical representative of the manufacturer 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. Instruction shall be 4 hours minimum.

B. The installing contractor shall functionally test each and every device in the entire system for proper operation and response. In addition, each circuit in the system shall be fully tested for wiring supervision. Any items found not properly installed or non-functioning shall be replaced or repaired and re-tested.

C. The installing contractor shall provide a complete written report on the functional test of the entire system. A copy of the test report shall be provided with maintenance manuals. The test report shall be signed and dated by the licensed fire alarm superintendent responsible for supervising the final system test and checkout.

D. 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.

E. It is the intent of these specifications and of the architect/engineer that a continued program of system maintenance be continued by the owner in compliance with NFPA 72, Chapter 7. It is mandatory that the installing contractor shall provide such services and make available these services to the owner upon completion of the project.

3.8 WARRANTY

A. The fire alarm system, 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 acceptance or beneficial occupancy, whichever shall occur first. Any equipment or workmanship shown to be defective shall be repaired, replaced, or adjusted during normal working hours at no cost to the owner.

B. 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.

3.9 GRAPHIC FLOOR PLANS

A. Provide (2) 1/16" = 1'-0" floor plan on each floor showing all devices and zoning. Zoning shall correspond to the zone on the fire alarm control panel and remote annunciator. The floor plans shall be framed with a glass cover and located by the fire alarm control panel and by each remote annunciator. Provide a sample for approval.

3.10 SPARE PARTS AND ATTIC STOCK

A. Provide 5% spare field devices including labor to install them. Devices not used shall be given to the Owner at time of job completion.

B. The fire alarm contractor shall include in his bid the cost to provide and install the additional spare parts and attic stock and associated cabling. All devices not used during construction shall be turned over to the owner at the time of job completion

END OF SECTION 284609.01

SECTION 311000 - SITE CLEARING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. All applicable provisions of the Bidding and Contract Requirements, and Division 1 - General Requirements shall govern the work under this section.

1.2 WORK INCLUDED

A. This Section includes the following:

1. Clearing and grubbing.
2. Stripping and stockpiling topsoil.
3. Temporary erosion and sedimentation control measures.

B. Related Sections include the following:

1. Division 32 Section "Chain Link Fences and Gates" for temporary construction fencing.

1.3 MATERIAL OWNERSHIP

A. Except for stripped topsoil or other materials indicated to remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.4 PROJECT CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
2. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.
3. Do not proceed with work on adjoining property until directed by Engineer.

B. Utility Locator Service: Notify utility locator service for area where Project is located before site clearing.

C. Do not commence site clearing operations until temporary erosion and sedimentation control measures are in place.

PART 2 - PRODUCTS (NOT USED)

PART 3 - PART 3 – EXECUTION

3.1 TEMPORARY EROSION AND SEDIMENTATION CONTROL

A. Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to sediment and erosion control Drawings.

B. Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.

C. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.2 TREE PROTECTION

A. Reference 015639 “Tree and Plant Protection”.

3.3 UTILITIES

A. Locate, identify, disconnect, and seal or cap off utilities indicated to be removed.

1. Arrange with utility companies to shut off indicated utilities.

B. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify Engineer and Owner not less than two days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Owner’s written permission.

C. Excavate for and remove underground utilities indicated to be removed.

3.4 CLEARING AND GRUBBING

A. Remove obstructions, trees, shrubs, grass, and other vegetation to permit installation of new construction.

1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.
2. Cut minor roots and branches of trees indicated to remain in a clean and careful manner where such roots and branches obstruct installation of new construction.
3. Grind stumps and remove roots, obstructions, and debris extending to a depth of 18 inches (450 mm) below exposed subgrade.

4. Use only hand methods for grubbing within tree protection zone.

B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.

1. Place fill material in horizontal layers not exceeding a loose depth of 8 inches (200 mm) and compact each layer to a density equal to adjacent original ground.

3.5 TOPSOIL STRIPPING

A. Remove sod and grass before stripping topsoil.

B. Strip topsoil to whatever depths are encountered in a manner to prevent intermingling with underlying subsoil or other waste materials.

1. Remove subsoil and non soil materials from topsoil, including trash, debris, weeds, roots, and other waste materials.

C. Stockpile topsoil materials away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust.

1. Limit height of topsoil stockpiles to 72 inches (1800 mm).
2. Do not stockpile topsoil within tree protection zones.
3. Dispose of excess topsoil as specified for waste material disposal.
4. Select subparagraph above or below.
5. Stockpile surplus topsoil to allow for respreading deeper topsoil.

3.6 SITE IMPROVEMENTS

A. Remove existing above- and below-grade improvements as indicated and as necessary to facilitate new construction.

B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.

1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut length of existing pavement to remain before removing existing pavement. Saw-cut faces vertically.
2. Paint cut ends of steel reinforcement in concrete to remain to prevent corrosion.

3.7 DISPOSAL

A. Disposal: Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.

1. Separate recyclable materials produced during site clearing from other nonrecyclable materials. Store or stockpile without intermixing with other materials and transport them to recycling facilities.

END OF SECTION 311000

SECTION 312000 - EARTH MOVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. All applicable provisions of the Bidding and Contract Requirements, and Division 1 - General Requirements shall govern the work under this section.

1.2 WORK INCLUDED

A. This Section includes the following:

1. Subgrade course for pavements.
2. Base material for asphalt paving.

B. All earthwork to be performed and materials used shall be in accordance with the Geotechnical Engineering Report. In the event of a discrepancy between the above-referenced standards, the plans, and/or any portion of this specification section, the order of precedence will be the above-referenced report, the City Design Standards, and then these specifications. The Contractor shall contact the engineer in the event of a discrepancy.

1.3 DEFINITIONS

A. Backfill: Soil material or controlled low-strength material used to fill an excavation.

1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
2. Final Backfill: Backfill placed over initial backfill to fill a trench.

B. Base Material: Course placed between the subgrade asphaltic concrete paving.

C. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.

D. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.

1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Engineer. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.

E. Fill: Soil materials used to raise existing grades.

F. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below base material.

1.4 SUBMITTALS

A. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated:

1. Classification according to ASTM D 2487 of each borrow soil material proposed for fill and backfill.
2. Laboratory compaction curve according to ASTM D 698 for each borrow soil material proposed for fill and backfill.

1.5 PROJECT CONDITIONS

A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted in writing by Owner and then only after arranging to provide temporary utility services according to requirements indicated.

1. Notify Owner not less than two days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Owner's written permission.
3. Contact utility-locator service for area where Project is located before excavating.

B. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies to shut off services if lines are active.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.

B. Satisfactory Soils: On-site soils are suitable for use as fill within the pavement areas, provided they are free from organics and debris. Select fill must be used for grade adjustments in the helipad area.

C. Unsatisfactory Soils: Materials, which do not comply with the requirements for acceptable material, or which cannot be compacted to the specified or indicated density.

D. Subgrade: Stabilize the subgrade to materials as specified by Texas Department of Transportation. The subgrade material should be compacted to at least 98 percent of the modified Proctor maximum dry density (AASHTO T-180).

E. Base Material: The limerock base course should have a minimum Limerock Bearing Ratio (LBR) of 100 and should be compacted to 98 percent of the modified Proctor maximum dry density (AASHTO T-180).

F. Select Fill: USCS Classification CL and/or SC, with a Plasticity Index between 10 and 20.

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 created by earthwork operations.

B. Provide protective insulating materials to protect subgrades and foundation soils against freezing temperatures or frost.

3.2 DEWATERING

A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.

B. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.

1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.

3.3 EXCAVATION, GENERAL

A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.

1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.

3.4 EXCAVATION FOR WALKS AND PAVEMENTS

A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

3.5 EXCAVATION FOR UTILITY TRENCHES

A. Excavate trenches to indicated gradients, lines, depths, and elevations.

B. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches (300 mm) higher than top of pipe or conduit, unless otherwise indicated.

C. Trench Bottoms: Excavate trenches 4 inches (100 mm) deeper than bottom of pipe elevation to allow for bedding course. Hand excavate for bell of pipe.

1. Excavate trenches 6 inches (150 mm) deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

3.6 SUBGRADE INSPECTION

A. Notify Testing Agency when excavations have reached required subgrade.

B. If Testing Agency determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.

1. Proof-roll subgrade below pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades. Completely proof-roll subgrade in one direction, repeating proof-rolling in direction perpendicular to first direction. Limit vehicle speed to 3 mph (5 km/h).
2. Proof-roll with a loaded 10-wheel, tandem-axle dump truck weighing not less than 20 tons.
3. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Engineer, and replace with compacted backfill or fill as directed.

C. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.

D. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Engineer, without additional compensation.

3.7 STORAGE OF SOIL MATERIALS

A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.

1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.8 BACKFILL

A. Place all backfill in strict accordance to Geotechnical Report for this project.

B. Place and compact backfill in excavations promptly, but not before completing the following:

1. Construction below finish grade including, where applicable, subdrainage, dampproofing, waterproofing, and perimeter insulation.

2. Surveying locations of underground utilities for Record Documents.
3. Testing and inspecting underground utilities.
4. Removing concrete formwork.
5. Removing trash and debris.
6. Removing temporary shoring and bracing, and sheeting.
7. Installing permanent or temporary horizontal bracing on horizontally supported walls.

C. Place backfill on subgrades free of mud, frost, snow, or ice.

3.9 SOIL FILL

A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.

B. Place and compact fill material in layers to required elevations as follows:

1. Under grass and planted areas, use satisfactory soil material.
2. Under walks and pavements, use satisfactory soil material.

C. Place soil fill on subgrades free of mud, frost, snow, or ice.

3.10 SOIL MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.

1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
2. Remove and replace or scarify and air dry otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

3.11 COMPACTION OF SOIL BACKFILLS AND FILLS

A. All compaction in strict accordance with Geotechnical recommendations.

B. Place backfill and fill soil materials in layers not more than 8 inches (200 mm) in loose depth for material compacted by heavy compaction equipment.

C. Place backfill and fill soil materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.

D. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D 698:

1. Under pavements, scarify and recompact existing subgrade and each layer of backfill or fill soil material at 95 percent. Refer to Geotechnical Report for thickness.

2. Under walkways, scarify and recompact top 6 inches (150 mm) below subgrade and compact each layer of backfill or fill soil material at 95 percent.
3. Under lawn or unpaved areas, scarify and recompact top 6 inches (150 mm) below subgrade and compact each layer of backfill or fill soil material at 95 percent.
4. For utility trenches, compact each layer of initial and final backfill soil material at 95 percent.

3.12 GRADING

A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.

1. Provide a smooth transition between adjacent existing grades and new grades.
2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.

3.13 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent geotechnical engineering testing agency to perform field quality-control testing.

B. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2922, and ASTM D 2937, as applicable. Tests will be performed at the following locations and frequencies:

1. Paved Areas: At subgrade and at each compacted fill and backfill layer, at least 1 test for every 2000 sq. ft. (186 sq. m) or less of paved area, as indicated in Geotechnical Report, but in no case fewer than 3 tests.
2. Trench Backfill: At each compacted initial and final backfill layer, at least 1 test for each 150 feet (46 m) or less of trench length, but no fewer than 2 tests.

C. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify, and moisten or aerate, or remove and replace soil to depth required; re-compact and retest until specified compaction is obtained.

3.14 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.

1. Scarify or remove and replace soil material to depth as directed by Engineer; reshape and recompact.

C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.

1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.15 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 312000

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SECTION 313213 - SOIL MIXING STABILIZATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. All applicable provisions of the Bidding and Contract Requirements, and Division 1 - General Requirements shall govern the work under this section.

B. This Section includes soil mixing stabilization and specialties outside the building, including the following:

1. Excavation, treatment, and backfilling of subgrade for lime stabilization.

C. All soil mixing stabilization to be performed and materials used shall be in accordance with the Geotechnical Engineering Report. In the event of a discrepancy between the above-referenced report and any portion of this specification section, the above-referenced report will govern. The Contractor shall contact the Engineer in the event of a discrepancy.

1.2 REFERENCE STANDARDS

A. American Society for Testing Materials (ASTM) latest edition

1. C150 Portland Cement
2. C618 Fly Ash and Raw or Calcined Natural Pozzolan for use as a Mineral Admixture in Portland Cement Concrete
3. C 977 Quicklime and Hydrated Lime for Soil Stabilization
4. D 1633 Compressive Strength of Molded Soil-Cement Cylinders

B. American Association of State Highway and Transportation Officials (AASHTO) latest edition

1. M 216 Lime for Soil Stabilization

C. National Lime Association (NLA)

D. Bulletin 326 Lime Stabilization Construction Manual

E. Texas Department of Transportation Standards

1. TXDOT Item 260 Lime Treatment (Road Mixed)
2. TXDOT Item 265 Fly Ash or Lime – Fly Ash Treatment (Road Mixed)

1.3 ENVIRONMENTAL REQUIREMENTS

A. Do not install mixed materials in wind in excess of 10 mph or when temperature is below 40 degrees Fahrenheit.

1.4 QUALITY ASSURANCE

A. Perform work in accordance with state and local standards in conjunction with requirements specified herein.

1.5 SUBMITTALS

A. Submit 30-pound sample of each material to be used at the site in airtight containers to the independent testing laboratory or submit gradation and certification of material that is to be used to the independent testing laboratory for review.

B. Submit name of each materials supplier and specific type and source of each material. Change in source requires approval of Owner.

C. Submit mix design and materials mix ratio that will achieve specified requirements of state and local agencies for soil stabilization.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Hydrated Lime: TXDOT Item 260

2.2 EQUIPMENT

A. Perform operations using suitable, well-maintained equipment capable of excavating subsoil, mixing, and placing materials, wetting, consolidating, and compacting of material.

PART 3 - EXECUTION

3.1 PREPARATION

A. Obtain approval from the independent testing laboratory of mix design before proceeding with placement.

B. Start stabilization only when weather and soil conditions are favorable for successful application of proposed material.

C. Proof roll subgrade to identify areas in need of stabilization in accordance with Section 312000.

3.2 EXCAVATION

A. Excavate subsoil to depth sufficient to accommodate soil stabilization.

B. Remove lumped subsoil, boulders, and rock that interfere with achieving uniform subsoil conditions.

C. Notify Construction Manager of unexpected subsurface conditions. Discontinue affected work in area until notified to resume work.

D. Correct areas over-excavated in accordance with Section 312000.

E. Remove excess excavated material from site.

3.3 SOIL TREATMENT AND BACKFILLING

A. Lime Stabilized Subgrade: Where indicated on Construction Drawings or as required after continual failure, treat prepared subgrade with hydrated lime in accordance with state highway department specifications (TXDOT Item 260).

1. A minimum of 48 hours of tempering time shall be provided before final mixing.
2. Subgrade soils shall be treated with lime at a rate of 6 to 8 percent lime, by dry weight.

B. Subsoil shall be in accordance with Section 312000.

C. Maintain optimum moisture of mixed materials to attain required stabilization and compaction.

D. Finish subgrade surface in accordance with Section 312000.

E. Remove surplus mix materials from site at no additional cost to the Owner.

3.4 CURING

A. Immediately following compaction of mix, seal top surface with curing seal.

B. Do not permit traffic for 72 hours after sealing top surface.

3.5 FIELD QUALITY CONTROL

A. Compression test and analysis of hardened fill material will be performed in accordance with Section 02300.

B. If tests indicate work does not meet specified requirements, remove work, replace, and retest, at no cost to owner.

END OF SECTION 313213

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SECTION 315000 - 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 Requirements:

1. Section 013233 "Photographic Documentation" for recording preexisting conditions and excavation support and protection system progress.
2. Section 312000 "Earth Moving" for excavating and backfilling and for controlling surface-water runoff and ponding.
3. Section 312319 "Dewatering" for dewatering excavations.

1.3 PREINSTALLATION MEETINGS

A. Pre-installation Conference: Conduct conference at Project site.

1. Review geotechnical report.
2. Review existing utilities and subsurface conditions.
3. Review coordination for interruption, shutoff, capping, and continuation of utility services.
4. Review proposed excavations.
5. Review proposed equipment.
6. Review monitoring of excavation support and protection system.
7. Review coordination with waterproofing.
8. Review abandonment or removal of excavation support and protection system.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, performance properties, and dimensions of individual components and profiles, and calculations for excavation support and protection system.

B. Shop Drawings: For excavation support and protection system, prepared by or under the supervision of a qualified professional engineer.

1. Include plans, elevations, sections, and details.
2. Show arrangement, locations, and details of soldier piles, piling, lagging, tiebacks, bracing, and other components of excavation support and protection system according to engineering design.
3. Indicate type and location of waterproofing.
4. Include a written plan for excavation support and protection, including sequence of construction of support and protection coordinated with progress of excavation.

1.5 INFORMATIONAL SUBMITTALS

A. Contractor Calculations: For excavation support and protection system. Include analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

B. Existing Conditions: Using photographs, show existing conditions of adjacent construction and site improvements that might be misconstrued as damage caused by inadequate performance of excavation support and protection systems. Submit before Work begins.

C. Record Drawings: Identify locations and depths of capped utilities, abandoned-in-place support, and protection systems, and other subsurface structural, electrical, or mechanical conditions.

1.6 FIELD 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 Owner no fewer than two 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 a geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by a geotechnical engineer. Owner is not responsible for interpretations or conclusions drawn from the data.

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. Clearly identify benchmarks and record existing elevations.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Provide, monitor, and maintain excavation support and protection system capable of supporting excavation sidewalls and of resisting earth and hydrostatic pressures and superimposed and construction loads.

1. Contractor Design: Design excavation support and protection system, including comprehensive engineering analysis by a qualified professional engineer.
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. Continuously monitor vibrations, settlements, and movements to ensure stability of excavations and constructed slopes and to ensure that damage to permanent structures is prevented.

2.2 MATERIALS

A. General: Provide materials that are either new or in serviceable condition.

B. Structural Steel: ASTM A 36/A 36M, ASTM A 690/A 690M, or ASTM A 992/A 992M.

C. 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] [Roll-formed corner shape with continuous interlock].

D. Wood Lagging: Lumber, mixed hardwood, nominal rough thickness of size and strength required for application.

E. Shotcrete: Comply with Section 033713 "Shotcrete" for shotcrete materials and mixes, reinforcement, and shotcrete application.

F. Cast-in-Place Concrete: ACI 301, of compressive strength required for application.

G. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, 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 construction and finishing of other work is not impeded.

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 vertical edges to form a continuous barrier.

B. 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. Accurately align exposed faces of sheet piling to vary not more than 2 inches from a horizontal line and not more than 1:120 out of vertical alignment.

C. Cut tops of sheet piling to uniform elevation at top of excavation.

3.4 TIEBACKS

A. Drill, install, grout, and tension tiebacks.

B. Test load-carrying capacity of each tieback and replace and retest deficient tiebacks.

1. Have test loading observed by a qualified professional engineer responsible for design of excavation support and protection system.

C. Maintain tiebacks in place until permanent construction is able to withstand lateral earth 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 FIELD QUALITY CONTROL

A. Survey-Work Benchmarks: Resurvey benchmarks as required during installation of excavation support and protection systems, excavation progress, and for as long as excavation remains open. Maintain 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.

B. Promptly correct detected bulges, breakage, or other evidence of movement to ensure that excavation support and protection system remains stable.

C. Promptly repair damages to adjacent facilities caused by installation or faulty performance of excavation support and protection systems.

3.7 REMOVAL AND REPAIRS

A. Remove excavation support and protection systems when construction has progressed sufficiently to support excavation and earth and hydrostatic pressures. Remove in stages to avoid disturbing underlying soils and rock or damaging structures, pavements, facilities, and utilities.

1. Remove excavation support and protection systems to a minimum depth of 48 inches below overlying construction and abandon remainder.
2. Fill voids immediately with approved backfill compacted to density specified in Section 312000 "Earth Moving."
3. Repair or replace, as approved by Architect, adjacent work damaged or displaced by removing excavation support and protection systems.

B. Leave excavation support and protection systems permanently in place.

END OF SECTION 315000

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SECTION 316329 – DRILLED CONCRETE PIERS AND SHAFTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Machine drilled shaft and belled base.

B. Concrete and reinforcement.

C. Shaft liner, if required.

1.2 RELATED REQUIREMENTS

A. Section 032000 - Concrete Reinforcing: Requirements for concrete reinforcement.

B. Section 033000 - Cast-in-Place Concrete: Requirements for concrete.

C. Section 310916.21 - Pile Load Tests: Requirements for pile load tests.

1.3 REFERENCE STANDARDS

A. ACI 336.1 - Specification for the Construction of Drilled Piers; 2001.

B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.

C. ASTM A252 - Standard Specification for Welded and Seamless Steel Pipe Piles; 2010 (Reapproved 2018).

D. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates; 2018.

E. ASTM A929/A929M - Standard Specification for Steel Sheet, Metallic-Coated by the Hot-Dip Process for Corrugated Steel Pipe; 2018.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.

1.5 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Installer's Qualification Statement.

C. Project Record Documents: Record actual locations of piers, pier diameter, and pier length. Accurately record the following:

D. Project Record Documents: Record actual locations of piers, pier diameter, and pier length. Accurately record the following:

1. Sizes, lengths, and locations of piers.
2. Sequence of placement.
3. Final base and top elevations.
4. Deviation from indicated locations.
5. Placement and configuration of reinforcement deviations.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing the work of this section with minimum 3 years of documented experience.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Casing: Temporary casings of steel complying with ASTM A283/A283M, Grade C; ASTM A36/A36M; or ASTM A929/A929M; of sufficient strength to withstand handling and drilling stresses, concrete pressures, and surrounding earth and water pressures.

B. Shaft Liner: ASTM A252, Grade 1; single length steel pipe, with plain ends, of diameter and wall thickness indicated.

C. Concrete Materials and Mix: Specified in Section 033000.

D. Reinforcement: Specified in Section 032000; spiral wound.

E. Equipment: Appropriate for dewatering excavated shaft.

PART 3 - EXECUTION

3.1 PREPARATION

A. Use placement method which will not cause damage to nearby structures.

B. Notify adjacent and affected landowners and building occupants with 90 days’ notice before proceeding with the work.

C. Protect structures near the work from damage.

D. Prepare to place piers from existing site elevations.

E. Grade perimeter of pier and shaft area to prevent surface water from draining into soil borings. Provide temporary means and methods, as required, to maintain surface diversion until no longer needed, or as directed by the Architect.

3.2 INSTALLATION

A. Construct piers in accordance with ACI 336.1.

B. Drill vertical pier shafts, belled bases, shear rings, and rock sockets to diameters and depths indicated.

C. Place steel casings immediately after drilling. Set firmly in place. If casing is to be temporary, install shaft liner with sufficient strength to withstand concrete pressures.

1. Withdrawal of temporary casings is at option of Contractor.

D. Clean shaft and bottom of loose material. Provide temporary means and methods, as required, to remove all water from soil borings as needed, or until directed by the Geotechnical Engineer.

E. Allow inspection of shaft and liner prior to placement of reinforcement and concrete.

F. Place reinforcing steel in accordance with Section 032000.

G. Place concrete in single pour, in accordance with Section 033000 with equipment designed for vertical placement of concrete.

H. Coordinate casing withdrawal with concrete placement so that concrete pressure head exceeds anticipated outside soil and water pressure above bottom of casing at all times during withdrawal.

I. Extend reinforcement for connection of caps.

J. Set tops of piers to elevations indicated.

3.3 TOLERANCES

A. Install piers with maximum variation from location, plumbness, bottom area, diameter, and anchorage locations as specified in ACI 336.1.

B. Maximum Variation From Vertical: 1 in 48.

C. Maximum Variation From Design Top Elevation: Plus 3 inches, minus 1 inch.

D. Maximum Out-of-Position: 2 inches.

3.4 FIELD QUALITY CONTROL

A. Field inspection and testing will be performed under provisions of Section 014000 - Quality Requirements.

B. Perform load tests to requirements of Section 310916.21.

C. Test Piers: Same diameter and type as specified for other piers, placed in same manner.

D. Accepted test piers may not be used in the Work.

3.5 UNACCEPTABLE PIERS

A. Unacceptable Piers: Piers that fail, are placed out of position, are below elevations, or are damaged.

B. B. Provide additional piers or replace piers failing to comply with specified requirements.

END OF SECTION 316329

SECTION 321313 - CONCRETE PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. All applicable provisions of the Bidding and Contract Requirements, and Division 1 – General Requirements shall govern the work under this section.

1.2 WORK INCLUDED

A. This Section includes exterior cement concrete pavement for driveways, parking lots, curbs and gutters, and walkways.

B. All concrete paving to be performed and materials to be used shall be in accordance with the Geotechnical Engineering Report and the applicable requirements in the American Concrete Institute's Manual of Concrete Practice. In the event of a discrepancy between the above-referenced report and any portion of this specification section, the above-referenced report will govern. The Contractor shall contact the Engineer in the event of a discrepancy.

1.3 SUBMITTALS

A. Mix Design: Submit one (1) copy of the Mix design prepared by the batch plant servicing the Project.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Manufacturer of ready-mixed concrete products who complies with ASTM C 94/C 94M requirements for production facilities and equipment.

1.5 PROJECT CONDITIONS

A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

PART 2 - PRODUCTS

2.1 FORMS

A. Form Materials: construction grade wood or metal, or other approved panel-type materials to provide full-depth, continuous, straight, smooth exposed surfaces.

B. 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.

2.2 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60.

B. Joint Dowel Bars: Plain steel bars, ASTM A 615/A 615M, Grade 60. Cut bars true to length with ends square and free of burrs.

C. Tie Bars: ASTM A 615/A 615M, Grade 60.

D. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded wire reinforcement, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete of greater compressive strength than concrete.

2.3 CONCRETE MATERIALS

A. Cementitious Material: Portland Cement: ASTM C 150, Type II

B. Normal-Weight Aggregates: ASTM C 33, Class 4S coarse aggregate, uniformly graded. Provide aggregates from a single source.

1. Maximum Coarse-Aggregate Size 1.5-inch nominal.
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

C. Water: ASTM C 94/C 94M.

D. Air-Entraining Admixture: ASTM C 260.

E. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and to contain no more than 0.1 percent water-soluble chloride ions by mass of cementitious material.

1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
2. Retarding Admixture: ASTM C 494/C 494M, Type B.
3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

2.4 CURING MATERIALS

A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. dry.

B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

C. Water: Potable.

2.5 RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber

2.6 PAVEMENT MARKINGS

A. Pavement-Marking Paint: Latex, waterborne emulsion, lead and chromate free, ready mixed, complying with FS TT-P-1952, with drying time of less than 45 minutes.

2.7 WHEEL STOPS

A. Wheel Stops: Precast, air-entrained concrete, 2500-ps minimum compressive strength,

4-1/2 inches high by 10 inches wide by 72 incheslong. Provide chamfered corners and holes for anchoring to substrate.

1. Dowels: Galvanized steel, 3/4-inch diameter, 18-inch minimum length.

2.8 CONCRETE MIXTURES

A. Prepare design mixtures, proportioned according to ACI 301, for each type and strength of normal-weight concrete determined by either laboratory trial mixes or field experience.

B. Proportion mixtures to provide normal-weight concrete with the following properties:

1. Compressive Strength (28 Days): 3,500 psi
2. Maximum Water-Cementitious Materials Ratio at Point of Placement: 0.50
3. Slump Limit: 4 inches

C. Add air-entraining admixture at manufacturer's prescribed rate to result in normal-weight concrete at point of placement having an air content as follows:

1. Air Content: do not exceed 2 percent

D. Chemical Admixtures: Use admixtures according to manufacturer's written instructions.

1. Use water-reducing 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.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.

B. Proof-roll prepared subbase surface below concrete pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding.

1. Completely proof-roll subbase in one direction and repeat in perpendicular direction. Limit vehicle speed to 3 mph.
2. Proof-roll with a 20-ton pneumatic roller or similar equipment, such as a fully loaded dump truck.
3. Subbase with soft spots and areas of pumping or rutting exceeding depth of 1/2 inch require correction according to requirements in Division 31 Section "Earth Moving."
4. Proceed with concrete pavement operations only after nonconforming conditions have been corrected and subgrade is ready to receive pavement.

3.2 PREPARATION

A. Remove loose material from compacted subbase surface immediately before placing concrete.

3.3 EDGE FORMS AND SCREED CONSTRUCTION

A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides for pavement to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.

B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

3.4 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.

C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.

3.5 JOINTS

A. General: Form construction, isolation, and contraction joints and tool edgings true to line with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline, unless otherwise indicated.

1. When joining existing pavement, place transverse joints to align with previously placed joints, unless otherwise indicated.

B. Construction Joints: Set construction joints at side and end terminations of pavement and at locations where pavement operations are stopped for more than one-half hour unless pavement terminates at isolation joints.

1. Continue steel reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of pavement strips, unless otherwise indicated.
2. Provide tie bars at sides of pavement strips where indicated.
3. Butt Joints: Use epoxy bonding adhesive at joint locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
4. Doweled Joints: Install dowel bars and support assemblies at joints where indicated.
5. Lubricate or asphalt-coat one-half of dowel length to prevent concrete bonding to one side of joint.

C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, walks, other fixed objects, and where indicated.

1. Extend joint fillers full width and depth of joint.
2. Terminate joint filler not less than 1/2 inch or more than 1 inch below finished surface if joint sealant is indicated.
3. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.
4. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
5. Protect top edge of joint filler during concrete placement with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.

D. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, as follows to match jointing of existing adjacent concrete pavement:

1. 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 developing random contraction cracks.
2. Doweled Contraction 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.

E. Edging: Tool edges of pavement, gutters, curbs, and joints in concrete after initial floating with an edging tool to a 3/8-inch radius. Repeat tooling of edges after applying surface finishes. Eliminate tool marks on concrete surfaces.

F. Joint sealants: Joints shall be sealed with approved exterior pavement joint sealants and shall be installed in accordance with manufacturer’s recommendations.

3.6 PAVEMENT MARKING

A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Engineer.

B. Allow concrete pavement to cure for 28 days and be dry before starting pavement marking.

C. Sweep and clean surface to eliminate loose material and dust.

D. Apply paint with mechanical equipment to produce pavement markings of dimensions indicated with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils.

3.7 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Testing Services: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:

1. Testing Frequency: Obtain at least 1 composite sample for each 100-cu. yd. or fraction thereof of each concrete mix placed each day.
2. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
3. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mix. Perform additional tests when concrete consistency appears to change.
4. Air Content: ASTM C 231, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mix.
5. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F (4.4 deg C) and below and when 80 deg F (27 deg C) and above, and one test for each composite sample.
6. Compression Test Specimens: ASTM C 31/C 31M; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.
7. Compressive-Strength Tests: ASTM C 39/C 39M; test 1 specimen at 7 days and 2 specimens at 28 days.

    a. A compressive-strength test shall be the average compressive strength from 2 specimens obtained from same composite sample and tested at 28 days.

C. Strength of each concrete mix will be satisfactory if average of any 3 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.

D. Test results shall be reported in writing to Engineer, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain 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.

E. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Engineer but will not be used as sole basis for approval or rejection of concrete.

F. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Engineer.

G. Remove and replace concrete pavement where test results indicate that it does not comply with specified requirements.

H. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

END OF SECTION 321313

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SECTION 321314 - CONCRETE SIDEWALK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. All applicable provisions of the Bidding and Contract Requirements, and Division 1 – General Requirements shall govern the work under this Section.

1.2 WORK INCLUDED

A. The work specified in this Section consists of the construction of concrete sidewalk in accordance with these Specifications and in conformity with the lines, grades, dimensions, and notes shown on the plans.

1.3 RELATED WORK

A. Section 024119 – Selective Demolition

B. Division 31 – Earthwork

PART 2 - PRODUCTS

2.1 CONCRETE

A. Concrete shall be Class A Concrete unless otherwise shown on the plans.

2.2 FORMS

A. Forms for this work shall be made of either wood or metal and shall have a depth equal to the plan dimensions for the depth of concrete being deposited against them. They shall be straight, free from warp or bends, and of sufficient strength when staked, to resist the lateral pressure of the concrete without displacement from lines and grade. Forms shall be cleaned each time they are used and shall be oiled prior to placing the concrete.

2.3 SUBGRADE AND GRADING

A. Excavation shall be made to the required depth, and the foundation material upon which the sidewalk is to be set shall be compacted to a firm, even surface, true to grade and cross-section, and shall be moist at the time that the concrete is placed.

2.4 JOINTS

A. Expansion joints between the sidewalk and the curb, and at all other locations indicated on the plans, shall be 1/4-inch wide, formed with a preformed joint filler. Preformed joint filler shall meet the requirements of AASHTO M153 or AASHTO M213.

B. Contraction joints may be of the open type or may be sawed. Open type contraction joints shall be formed by staking a metal bulkhead in place and depositing the concrete on both sides. After the concrete has set sufficiently to preserve the width and shape of the joint, the bulkhead shall be removed. After the sidewalk has been finished over the joint, the slot shall be edged with a tool having a 1/2-inch radius.

If the CONTRACTOR elects to saw the contraction joints, a slot approximately 1/8-inch-wide and not less than 1-1/2 inches deep shall be cut with a concrete saw after the concrete has set, and within the following periods of time:

Contraction joints shall be constructed at not more than twenty (20) foot intervals and shall be in place within twelve (12) hours after finishing.

PART 3 - EXECUTION

3.1 PLACING

A. The concrete shall be placed in the forms to the required depth and shall be vibrated and spaded until mortar entirely covers its surface.

3.2 FINISHING

A. Screeding: The concrete shall be struck-off by means of a wood or metal screed, used perpendicular to the forms, and floated in order to obtain the required grade and remove surplus water and laitance.

B. Surface requirements: The concrete shall be given a broom finish. The surface variations shall not be more than 1/4 inch under a ten-foot straightedge, nor more than 1/8 inch on a five-foot transverse section. The exposed edge of the slab shall be carefully finished with an edging tool having a radius of 1-1/2 inch.

3.3 CURING

A. The concrete shall be continuously cured for a period of at least 72 hours. Curing shall be commenced after finishing has been completed and as soon as the concrete has hardened sufficiently, to permit application of the curing material without marring the surface.

B. Wet burlap, white-pigmented curing compound, waterproof paper or polyethylene sheets may be used for the curing.

END OF SECTION 321314

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SECTION 321373 - CONCRETE PAVING JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. All applicable provisions of the Bidding and Contract Requirements, and Division 1 – General Requirements shall govern the work under this section.

1.2 WORK INCLUDED

A. This Section includes the following:

1. Expansion and contraction joints within cement concrete pavement.
2. Joints between cement concrete and asphalt pavement.

1.3 SUBMITTALS

A. Product Data: For each joint-sealant product indicated. In the event of a discrepancy between this specification section and the City Design Criteria, the City’s Design Criteria shall govern. The Contractor shall notify the Engineer in the event of a discrepancy.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by manufacturer.

B. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Project site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration date, pot life, curing time, and mixing instructions for multicomponent materials.

B. Store and handle materials to comply with manufacturer's written instructions to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

1.6 PROJECT CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F.
2. When joint substrates are wet or covered with frost.
3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Compatibility: Provide joint sealants, backing materials, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer based on testing and field experience.

2.2 COLD-APPLIED JOINT SEALANTS

A. Type NS Silicone Sealant for Concrete: Single-component, low-modulus, neutral-curing, nonsag silicone sealant complying with ASTM D 5893 for Type NS.

1. Available Products:

a. Crafco Inc.; RoadSaver Silicone.
b. Dow Corning Corporation; 888.

B. Type SL Silicone Sealant for Concrete and Asphalt: Single-component, low-modulus, neutral-curing, self-leveling silicone sealant complying with ASTM D 5893 for Type SL.

1. Available Products:

a. Crafco Inc.; RoadSaver Silicone SL.
b. Dow Corning Corporation; 890-SL.

2.3 HOT-APPLIED JOINT SEALANTS

A. Elastomeric Sealant for Concrete: Single-component formulation complying with ASTM D 3406.

1. Available Products:

a. Crafco Inc.; Superseal 444/777.
b. Meadows, W. R., Inc.; Poly-Jet 3406.

B. Sealant for Concrete and Asphalt: Single-component formulation complying with ASTM D 3405.

1. Available Products:

    a. Koch Materials Company; Product No. 9005.
    b. Koch Materials Company; Product No. 9030.
    c. Meadows, W. R., Inc.; Sealtight Hi-Spec.
    d. Approved equals.

2.4 JOINT-SEALANT BACKER MATERIALS

A. General: Provide joint-sealant backer materials that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by joint-sealant manufacturer based on field experience and laboratory testing.

B. Round Backer Rods for Cold- and Hot-Applied Sealants: ASTM D 5249, Type 1, of diameter and density required to control sealant depth and prevent bottom-side adhesion of sealant.

C. Backer Strips for Cold- and Hot-Applied Sealants: ASTM D 5249; Type 2; of thickness and width required to control sealant depth, prevent bottom-side adhesion of sealant, and fill remainder of joint opening under sealant.

D. Round Backer Rods for Cold-Applied Sealants: ASTM D 5249, Type 3, of diameter and density required to control sealant depth and prevent bottom-side adhesion of sealant.

2.5 PRIMERS

A. Primers: Product recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions.

1. Joint Priming: Prime joint substrates where indicated or where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or

prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

3.3 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated unless more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Install backer materials of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

1. Do not leave gaps between ends of backer materials.
2. Do not stretch, twist, puncture, or tear backer materials.
3. Remove absorbent backer materials that have become wet before sealant application and replace them with dry materials.

D. Install sealants using proven techniques that comply with the following and at the same time backings are installed:

1. Place sealants so they directly contact and fully wet joint substrates.
2. Completely fill recesses provided for each joint configuration.
3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

E. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

1. Remove excess sealants from surfaces adjacent to joint.
2. Use tooling agents that are approved in writing by joint-sealant manufacturer and that do not discolor sealants or adjacent surfaces.

F. Provide joint configuration to comply with joint-sealant manufacturer's written instructions, unless otherwise indicated.

G. Provide recessed joint configuration for silicone sealants of recess depth and at locations indicated.

3.4 CLEANING

A. Clean off excess sealants or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved by manufacturers of joint sealants and of products in which joints occur.

3.5 PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately and replace with joint sealant so installations with repaired areas are indistinguishable from the original work.

END OF SECTION 321373

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SECTION 321723 - PAVEMENT MARKINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. All applicable provisions of the bidding and Contract Requirements, and Division 1 – General Requirements shall govern the work under this Section.

1.2 WORK INCLUDED

A. The work covered by this Section shall include the furnishing of all labor, equipment and materials necessary to construct and install all pavement marking, and striping in accordance with the plans and these specifications.

1.3 RELATED WORK

A. Section 321216 – Asphalt Paving

B. Section 321313 – Concrete Paving

1.4 QUALITY ASSURANCE

A. Perform all work in accordance with the requirements of local agencies.

PART 2 - PRODUCTS

2.1 PAVEMENT MARKINGS

A. Chlorinated rubber-alkyd type, as per Fed Spec. No. TT-P-115, Type III, or conforming to the applicable Sections of the Texas Department of Transportation Standard Specifications.

1. Paint shall be factory mixed, quick drying and non-bleeding type.
2. Color shall be as per D.O.T. requirements.
3. Striping, arrows, lane markers and stop bars shall be provided with paint containing reflective additive.

B. Thermoplastic paint shall conform to the applicable Sections of the Texas Department of Transportation Standard Specifications.

C. Traffic paint shall conform to the applicable Sections of the Texas Department of Transportation Standard Specifications.

PART 3 - EXECUTION

3.1 TRAFFIC AND LANE MARKINGS

A. Sweep dust and loose material from the sealed surface.

B. Apply paint striping as indicated on the drawings, with suitable mechanical equipment to produce uniform straight edges.

1. Apply in not less than (2) two coats as per manufacturer's recommended rates of applications.

C. Protect pavement markings until completely dry in accordance with manufacturer’s recommendations.

END OF SECTION 321723

SECTION 330500 - COMMON WORK RESULTS FOR UTILITIES

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. Piping joining materials.
2. Transition fittings.
3. Dielectric fittings.
4. Sleeves.
5. Identification devices.
6. Grout.
7. Flowable fill.
8. Piped utility demolition.
9. Piping system common requirements.
10. Equipment installation common requirements.
11. Painting.
12. Concrete bases.
13. Metal supports and anchorages.

1.3 DEFINITIONS

A. Exposed Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions.

B. Concealed Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

C. ABS: Acrylonitrile-butadiene-styrene plastic.

D. CPVC: Chlorinated polyvinyl chloride plastic.

E. PE: Polyethylene plastic.

F. PVC: Polyvinyl chloride plastic.

1.4 ACTION SUBMITTALS

A. Product Data: For the following:

1. Dielectric fittings.
2. Identification devices.

1.5 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.6 QUALITY ASSURANCE

A. Steel Support Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Steel Piping Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. Comply with ASME A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.8 COORDINATION

A. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

B. Coordinate installation of identifying devices after completing covering and painting if devices are applied to surfaces.

C. Coordinate size and location of concrete bases.

PART 2 - PRODUCTS

2.1 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inchmaximum thickness, unless otherwise indicated.
   a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
   b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

2. AWWA C110, rubber, flat face, 1/8-inch-thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

E. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

F. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

G. Solvent Cements for Joining Plastic Piping:

1. ABS Piping: ASTM D 2235.
2. CPVC Piping: ASTM F 493.
3. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
4. PVC to ABS Piping Transition: ASTM D 3138.
5. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

2.2 TRANSITION FITTINGS

A. Transition Fittings, General: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.

B. Transition Couplings NPS 1-1/2 (DN 40) and Smaller:

1. Underground Piping: Manufactured piping coupling or specified piping system fitting.
2. Aboveground Piping: Specified piping system fitting.

C. AWWA Transition Couplings NPS 2 (DN 50) and Larger:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements.
3. Description: AWWA C219, metal sleeve-type coupling for underground pressure piping.

D. Plastic-to-Metal Transition Fittings:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements.
3. Description: PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint or threaded end.

E. Plastic-to-Metal Transition Unions:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements.
3. Description: MSS SP-107, PVC four-part union. Include brass or stainless-steel threaded end, solvent-cement-joint or threaded plastic end, rubber O-ring, and union nut.

F. Flexible Transition Couplings for Underground Nonpressure Drainage Piping:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements.
3. Description: ASTM C 1173 with elastomeric sleeve, ends same size as piping to be joined, and corrosion-resistant metal band on each end.

2.3 DIELECTRIC FITTINGS

A. Dielectric Fittings, General: Assembly of copper alloy and ferrous materials or ferrous material body with separating nonconductive insulating material suitable for system fluid, pressure, and temperature.

B. Dielectric Unions:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements.
3. Description: Factory fabricated, union, NPS 2 (DN 50) and smaller.

a. Pressure Rating: 150 psig minimum at 180 deg F.
b. End Connections: Solder-joint copper alloy and threaded ferrous; threaded ferrous.

C. Dielectric Flanges:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements.
3. Description: Factory-fabricated, bolted, companion-flange assembly, NPS 2-1/2 to NPS 4 (DN 65 to DN 100) and larger.

a. Pressure Rating: 150 psig minimum.
b. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Kits:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements.
3. Description: Nonconducting materials for field assembly of companion flanges, NPS 2-1/2 (DN 65) and larger.

a. Pressure Rating: 150 psig minimum.
b. Gasket: Neoprene or phenolic.
c. Bolt Sleeves: Phenolic or polyethylene.
d. Washers: Phenolic with steel backing washers.

E. Dielectric Couplings:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements.
3. Description: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining, NPS 3 (DN 80) and smaller.

a. Pressure Rating: 300 psig at 225 deg F.
b. End Connections: Threaded.

F. Dielectric Nipples:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements.
3. Description: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining.

a. Pressure Rating: [300 psig (2070 kPa) at 225 deg F (107 deg C)] <Insert pressure and temperature>.
b. End Connections: Threaded or grooved.

2.4 SLEEVES

A. Mechanical sleeve seals for pipe penetrations are specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

B. Galvanized-Steel Sheet Sleeves: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.

C. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized, plain ends.

D. Cast-Iron Sleeves: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

E. Molded PVC Sleeves: Permanent, with nailing flange for attaching to wooden forms.

F. PVC Pipe Sleeves: ASTM D 1785, Schedule 40.

G. Molded PE Sleeves: Reusable, PE, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

2.5 IDENTIFICATION DEVICES

A. General: Products specified are for applications referenced in other utilities Sections. If more than single type is specified for listed applications, selection is Installer's option.

B. Equipment Nameplates: Metal permanently fastened to equipment with data engraved or stamped.

1. Data: Manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliances, and essential data.
2. Location: Accessible and visible.

C. Stencils: Standard stencils prepared with letter sizes complying with recommendations in ASME A13.1. Minimum letter height is 1-1/4 inches for ducts, and 3/4 inch for access door signs and similar operational instructions.

1. Material: Fiberboard, Brass.
2. Stencil Paint: Exterior, oil-based, alkyd-gloss black enamel, unless otherwise indicated. Paint may be in pressurized spray-can form.
3. Identification Paint: Exterior, oil-based, alkyd enamel in colors according to ASME A13.1, unless otherwise indicated.

D. Snap-on Plastic Pipe Markers: Manufacturer's standard preprinted, semirigid, snap-on type. Include color-coding according to ASME A13.1, unless otherwise indicated.

E. Pressure-Sensitive Pipe Markers: Manufacturer's standard preprinted, color-coded, pressure-sensitive-vinyl type with permanent adhesive.

F. Pipes with OD, Including Insulation, Less Than 6 Inches: Full-band pipe markers, extending 360 degrees around pipe at each location.

G. Pipes with OD, Including Insulation, 6 Inches and Larger: Either full-band or strip-type pipe markers, at least three times letter height and of length required for label.

H. Lettering: Manufacturer's standard preprinted captions as selected by Architect.

I. Lettering: Use piping system terms indicated and abbreviate only as necessary for each application length.

1. Arrows: Either integrally with piping system service lettering to accommodate both directions of flow, or as separate unit on each pipe marker to indicate direction of flow.

J. Plastic Tape: Manufacturer's standard color-coded, pressure-sensitive, self-adhesive vinyl tape, at least 3 mils thick.

1. Width: 1-1/2 inches on pipes with OD, including insulation, less than 6 inches; 2-1/2 inches for larger pipes.
2. Color: Comply with ASME A13.1, unless otherwise indicated.

K. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch sequenced numbers. Include 5/32-inch hole for fastener.

1. Material: 0.032-inch- thick, [polished brass] [or] [aluminum].
2. Material: 0.0375-inch- thick stainless steel.
3. Material: 3/32-inch- thick plastic laminate with 2 black surfaces and a white inner layer.
4. Material: Valve manufacturer's standard solid plastic.
5. Size: 1-1/2 inches in diameter, unless otherwise indicated.
6. Shape: As indicated for each piping system.

L. Valve Tag Fasteners: Brass, wire-link, or beaded chain; or brass S-hooks.

M. Engraved Plastic-Laminate Signs: ASTM D 709, Type I, cellulose, paper-base, phenolic-resin-laminate engraving stock; Grade ES-2, black surface, black phenolic core, with white melamine subcore, unless otherwise indicated. Fabricate in sizes required for message. Provide holes for mechanical fastening.

1. Engraving: Engraver's standard letter style, of sizes and with terms to match equipment identification.
2. Thickness: 1/16 inch unless otherwise indicated.
3. Thickness: 1/16 inch, for units up to 20 sq. in. or 8 inches in length, and 1/8 inch for larger units.
4. Fasteners: Self-tapping, stainless-steel screws, or contact-type permanent adhesive.

N. Plastic Equipment Markers: Manufacturer's standard laminated plastic, in the following color codes:

1. Green: Cooling equipment and components.
2. Yellow: Heating equipment and components.
3. Brown: Energy reclamation equipment and components.
4. Blue: Equipment and components that do not meet criteria above.
5. Hazardous Equipment: Use colors and designs recommended by ASME A13.1.
6. Terminology: Match schedules as closely as possible. Include the following:

    a. Name and plan number.
    b. Equipment service.
    c. Design capacity.
    d. Other design parameters such as pressure drop, entering and leaving conditions, and speed.

7. Size: 2-1/2 by 4 inches for control devices, dampers, and valves; 4-1/2 by 6 inches for equipment.

O. Plasticized Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with mat finish suitable for writing.

1. Size: 3-1/4 by 5-5/8 inches.
2. Fasteners: Brass grommets and wire.
3. Nomenclature: Large-size primary caption such as DANGER, CAUTION, or DO NOT OPERATE.

P. Lettering and Graphics: Coordinate names, abbreviations, and other designations used in piped utility identification with corresponding designations indicated. Use numbers, letters, and terms indicated for proper identification, operation, and maintenance of piped utility systems and equipment.

1. Multiple Systems: Identify individual system number and service if multiple systems of same name are indicated.

2.6 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.

1. Characteristics: Post hardening, volume adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000-psi, 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

2.7 FLOWABLE FILL

A. Description: Low-strength-concrete, flowable-slurry mix.

1. Cement: ASTM C 150, Type I, Portland.
2. Density: 115- to 145-lb/cu. ft.
3. Aggregates: ASTM C 33, natural sand, fine and crushed gravel or stone, coarse.

4. Aggregates: ASTM C 33, natural sand, fine.
5. Admixture: ASTM C 618, fly-ash mineral.
6. Water: Comply with ASTM C 94/C 94M.
7. Strength: 100 to 200 psig at 28 days.

PART 3 - EXECUTION

3.1 PIPED UTILITY DEMOLITION

A. Refer to Section 024119 "Selective Demolition" for general demolition requirements and procedures.

B. Disconnect, demolish, and remove piped utility systems, equipment, and components indicated to be removed.

1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
2. Piping to Be Abandoned in Place: Drain piping. Fill abandoned piping with flowable fill, and cap or plug piping with same or compatible piping material.
3. Equipment to Be Removed: Disconnect and cap services and remove equipment.
4. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make operational.
5. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.

C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.2 DIELECTRIC FITTING APPLICATIONS

A. Dry Piping Systems: Connect piping of dissimilar metals with the following:

1. NPS 2 and Smaller: Dielectric unions.
2. NPS 2-1/2 to NPS 12: Dielectric flanges.

B. Wet Piping Systems: Connect piping of dissimilar metals with the following:

1. NPS 2 and Smaller: Dielectric.
2. NPS 2-1/2 to NPS 4: Dielectric nipples.
3. NPS 2-1/2 to NPS 8: Dielectric nipples.
4. NPS 10 and NPS 12: Dielectric flange kits.

3.3 PIPING INSTALLATION

A. Install piping according to the following requirements and utilities Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on the Coordination Drawings.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping to permit valve servicing.

E. Install piping at indicated slopes.

F. Install piping free of sags and bends.

G. Install fittings for changes in direction and branch connections.

H. Select system components with pressure rating equal to or greater than system operating pressure.

I. Sleeves are not required for core-drilled holes.

J. Permanent sleeves are not required for holes formed by removable PE sleeves.

K. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.

1. Cut sleeves to length for mounting flush with both surfaces.

a. Exception: Extend sleeves installed in floors of equipment areas or other wet areas [2 inches above finished floor level.

2. Install sleeves in new walls and slabs as new walls and slabs are constructed.

a. PVC or Steel Pipe Sleeves: For pipes smaller than NPS 6.
b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.

L. Verify final equipment locations for roughing-in.

M. Refer to equipment specifications in other Sections for roughing-in requirements.

3.4 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and utilities Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

E. Welded Joints: Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

F. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

G. Grooved Joints: Assemble joints with grooved-end pipe coupling with coupling housing, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions.

H. Soldered Joints: Apply ASTM B 813 water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy (0.20 percent maximum lead content) complying with ASTM B 32.

I. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

J. Pressure-Sealed Joints: Assemble joints for plain-end copper tube and mechanical pressure seal fitting with proprietary crimping tool to according to fitting manufacturer's written instructions.

K. Plastic Piping Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 appendixes.
3. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
4. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
5. PVC Nonpressure Piping: Join according to ASTM D 2855.
6. PVC to ABS Nonpressure Transition Fittings: Join according to ASTM D 3138 Appendix.

L. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.

M. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.

N. Plastic Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.

1. Plain-End PE Pipe and Fittings: Use butt fusion.
2. Plain-End PE Pipe and Socket Fittings: Use socket fusion.

O. Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

3.5 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
3. Install dielectric fittings at connections of dissimilar metal pipes.

3.6 EQUIPMENT INSTALLATION

A. Install equipment level and plumb, unless otherwise indicated.

B. Install equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference with other installations. Extend grease fittings to an accessible location.

C. Install equipment to allow right of way to piping systems installed at required slope.

3.7 PAINTING

A. Painting of piped utility systems, equipment, and components is specified in Section 099113 "Exterior Painting," Section 099123 "Interior Painting," and Section 099600 "High-Performance Coatings."

B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.8 IDENTIFICATION

A. Piping Systems: Install pipe markers on each system. Include arrows showing normal direction of flow.

1. Stenciled Markers: According to ASME A13.1.
2. Plastic markers, with application systems. Install on insulation segment if required for hot non insulated piping.
3. Locate pipe markers on exposed piping according to the following:
4. Near each valve and control device.
5. Near each branch, excluding short takeoffs for equipment and terminal units. Mark each pipe at branch if flow pattern is not obvious.
6. Near locations where pipes pass through walls or floors or enter inaccessible enclosures.
7. At manholes and similar access points that permit view of concealed piping.

8. Near major equipment items and other points of origination and termination.

B. Equipment: Install engraved plastic-laminate sign or equipment marker on or near each major item of equipment.

1. Lettering Size: Minimum 1/4-inch-high for name of unit if viewing distance is less than 24 inches, 1/2-inch-high for distances up to 72 inches, and proportionately larger lettering for greater distances. Provide secondary lettering two-thirds to three-fourths of size of principal lettering.
2. Text of Signs: Provide name of identified unit. Include text to distinguish among multiple units, inform user of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.

C. Adjusting: Relocate identifying devices that become visually blocked by work of this or other Divisions.

3.9 CONCRETE BASES

A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.

1. Construct concrete bases of dimensions indicated, but not less than 4 inches (100 mm) larger in both directions than supported unit.
2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of base.
3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to supported equipment.
6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
7. Use 3000-psi, 28-day compressive-strength concrete, and reinforcement.

3.10 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Section 055000 "Metal Fabrications" for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor piped utility materials and equipment.

C. Field Welding: Comply with AWS D1.1/D1.1M.

3.11 GROUTING

A. Mix and install grout for equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

END OF SECTION 330500

SECTION 331110 - PVC WATER PIPE

PART 1 - GENERAL

1.1 DESCRIPTION

A. This specification covers the requirements to install polyvinyl chloride (PVC) water pipe and ductile iron fittings for the water line, including excavation, sheeting, shoring, dewatering, pipe laying, jointing, testing, backfilling, and any other work that is required or necessary to complete the installation as shown on the Plans and as specified herein.

1.2 SUBMITTALS

A. Comply with pertinent provisions of Division 1.

B. The Contractor shall submit descriptive information and evidence that the materials and equipment the Contractor proposes for incorporation into the Work is of the kind and quality that satisfies the specified functions and quality.

1.3 QUALITY ASSURANCE

A. All PVC pipe and fittings shall be from a single Manufacturer. The supplier shall be responsible for the provisions of all test requirements specified in ASTM D3034 or ASTM F789 and/or ASTM F758 as applicable.

PART 2 - PRODUCTS

2.1 POLYVINYL CHLORIDE (PVC) PIPE AND FITTINGS

A. Polyvinyl chloride pipe for water lines, unless otherwise specifically shown on the Plans, or approved in writing, shall be AWWA C900, C905, or C909 Class 150 psi with a dimension ratio of 18 (DR-18), for water lines and shall be extruded, be of rubber gasket type, and be furnished in 20-foot nominal laying lengths. All such pipe shall bear a mark denoting approval by the Underwriters' Laboratories of Chicago, Illinois, so that it will be acceptable to the Texas State Fire Insurance Commission for use in fire protection lines without penalty. All joints shall be of the type which provides a recession in the bell for the employment of a single rubber gasket to be placed before the insertion of the succeeding spigot. Each size of polyvinyl chloride pipe shall have the same outside diameter as the corresponding size of cast iron pipe.

B. Fittings shall be ductile iron, mechanical joint or flanged type and shall be Class 250 in accordance with AWWA Specifications C110-77, C-111-80, and C115-75. Flanges shall be faced and drilled in accordance with ASA Standard B16.1, Class 125 unless otherwise shown on the Plans or in the Special Conditions. All fittings shall be tar coated on the outside surface and shall have an interior

cement lining with seal coat per AWWA Specifications C104-80 unless otherwise shown or specified.

C. The Contractor shall obtain installation instructions, including support spacing and solvent welding, from the supplying Manufacturer, shall comply with the instructions, and shall meet the requirements of ASTM D-2855, Standard Recommended Practice for making Solvent Cemented Joints with PVC Pipe and Fittings. The PVC solvent cement shall comply with ASTM D-2564 and shall be furnished by the pipe and fitting Manufacturer for the class and type of pipe supplied to the project.

PART 3 - EXECUTION

3.1 HANDLING AND CUTTING PIPE

A. Pipe and fittings are slightly brittle. Care shall be taken in shipping, handling, and laying to avoid damaging the pipe and fittings. Extra care will be necessary during cold weather construction.

B. Any pipe or fitting showing a crack or which has received a blow that may have caused an incipient fracture, even though no such fracture can be seen, shall be marked as rejected and removed at once from the work.

C. All pipe ends shall be square after cutting.

D. While stored, pipe shall be adequately supported from below at not more than three (3) foot intervals to prevent deformation. Pipe shall not be stacked higher than six (6) feet. Pipe and fittings shall be stored in a manner which will keep them at ambient outdoor temperatures and out of direct sunlight. Temporary shading as required to meet this requirement shall be provided. Simple covering of the pipe and fittings which allows temperature buildup when exposed to direct sunlight will not be permitted.

3.2 JOINTING POLYVINYL CHLORIDE (PVC) PIPE AND FITTINGS

A. PVC pipe and fittings shall be jointed in accordance with the recommendations of the latest ASTM Standards and detailed instructions of the Manufacturer.

3.3 INSTALLING POLYVINYL CHLORIDE (PVC) PIPE AND FITTINGS

A. Unless otherwise specified on the Plans, polyvinyl chloride pipe shall be installed to clear all utility lines and shall have three (3) feet minimum cover. For water lines to be constructed under a future roadway, the cover may be increased to allow for future paving grades. The depth of cover, shown on the Plans, is that distance from the top of the pipe to the approximate proposed grade line.

B. No single piece of pipe shall be laid unless it is generally straight. The centerline of the pipe shall not deviate from a straight line drawn between the centers of the openings at the ends of the pipe by more than 1/16-inch per foot of length. If a piece of pipe fails to meet this requirement check

for straightness, it shall be rejected and removed from the site. Laying instructions of the Manufacturer shall be explicitly followed.

C. Any pipe or fittings discovered to be defective after laying shall be removed and replaced with a sound piece.

D. The Engineer or the City may examine each bell and spigot end to determine whether any preformed joint has been damaged prior to installation. Any pipe having defective joint surfaces shall be rejected, marked as such, and immediately removed from the job site.

E. All pipe shall be sound and clean before laying. When laying is not in progress, including lunch time, the open ends of the pipe shall be closed by watertight plugs or other approved means. Good alignment shall be preserved in laying.

F. Pipe and fittings shall be installed in accordance with the instructions of the Manufacturer, ASTM D2321 and as specified herein. As soon as the excavation is complete to normal grade of the bottom of the trench, embedment material shall be placed, compacted, and graded to provide firm, uniform, and continuous support for the pipe. Bell holes shall be excavated so that only the barrel of the pipe bears upon the bedding. The pipe shall be laid accurately to the lines and grades indicated on the Plans. The specified embedment shall be accurately shaped and trimmed to receive the pipe barrel and each pipe section, when in place, shall have a uniform bearing on the subgrade for the full length of the pipe barrel. Pipe shall not be laid unless the subgrade is free of water and in a satisfactory condition. Embedment material shall be placed evenly on each side of the pipe to mid-diameter and hand tools shall be used to force the embedment material under the haunches of the pipe and into the bell holes to give firm continuous support for the pipe. Embedment material shall then be placed to 12-inches above the top of the pipe. Next, the varying depths of select material backfill above the embedment material backfill shall be placed according to the Plan Details and carefully compacted. Generally, the compaction shall be done evenly on each side of the pipe and compaction equipment shall not be operated directly over the pipe until sufficient select material backfill has been placed to ensure that such compaction equipment will not have a damaging effect on the pipe. Equipment used in compacting the varying depths of select material backfill shall be approved by the pipe Manufacturer's representative prior to use. Adjustments of the pipe to line and grade shall be made by scraping away or filling in with granular material, and not by wedging or blocking up the bell.

G. Perforated PVC Pipe and fittings shall be installed in accordance with the instructions of the Manufacturer, ASTM F758 and as specified herein. As soon as the excavation for the trench is complete to normal grade of the bottom of the trench, geotextile fabric shall be laid and then the pea gravel bedding shall be carefully placed (so not to damage the geotextile fabric) and graded to provide uniform and continuous support for the pipe. Bell holes shall be excavated so that only the barrel of the pipe bears upon the bedding. Before the perforated pipe is laid on the trench, the perforated pipe shall be wrapped around and closed according to the Manufacturer's closure recommendations with the geotextile fabric. The pipe shall be laid accurately to the lines and grades indicated on the Plans. Blocking under the perforated PVC pipe will not be permitted. Pea gravel shall be placed evenly on each side of the pipe to mid-diameter and hand tools shall be used to gently place the pea gravel under the haunches of the pipe and into the bell holes to give firm continuous support for the pipe. Making sure not to damage the geotextile fabric, pea gravel shall then be carefully placed above the top of the perforated pipe varying from two to three (2-3) feet depending on the Plans. Once the remaining pea gravel has been placed, overlap or close the geotextile fabric according to the Manufacturer's recommendations or six (6) inches minimum

overlap. Then one (1) foot of topsoil shall be placed over the pea gravel to the ground level with proper grass sodding on top.

H. Joints shall not be “pulled” or “cramped.” Each joint of pipe shall be completed in compliance with Manufacturer’s recommendations.

I. Before any joint is made, the pipe shall be checked to assure that a close joint with the next adjoining pipe has been maintained and that the inverts are matched and conform to the required grade. The pipe shall not be driven down to grade by striking it.

J. Precautions shall be taken to prevent flotation of the pipe in the trench.

K. When moveable trench bracing such as trench boxes, moveable sheeting, shoring, or plates are used to support the sides of the trench, care shall be taken in placing and moving the boxes or supporting bracing to prevent movement of the pipe, or disturbance of the pipe bedding and backfill or embedment material. Trench boxes, moveable sheeting, shoring or plates shall not be allowed to extend below mid-diameter of the pipe. As trench boxes, moveable sheeting, shoring, or plates are moved, embedment material shall be placed to fill any voids created and the embedment material and backfill shall be recompacted to provide uniform side support for the pipe.

3.4 CONCRETE AND BLOCKING

A. 2,500 psi concrete shall be placed for blocking at each change in direction in the pipeline, as shown in the Standard Details and in such manner as will substantially brace the pipe against undisturbed trench walls. In no event shall this quantity of concrete blocking be less than those shown in the Plans. Concrete blocking, made from Type I cement, shall have been in place four (4) days prior to testing the pipeline as hereinafter specified. Tests may be made in two (2) days after completion of blocking if Type III cement is used.

B. At all points where wet connections are made to existing lines, the existing lines shall be adequately blocked, and the tapping connection fittings shall be supported by blocking up to the spring line with 2,500 psi concrete.

3.5 LEAKING TESTING AND STERILIZATION

A. General

1. All leakage testing and sterilization shall be per Utility Owner’s requirements. Contractor to coordinate with Utility Owner for procedures, timing, and witnessing of testing and sterilization. This section outlines minimum requirements and guidelines for testing and sterilization.
2. After the pipe has been laid and backfilled and the backfill has been otherwise consolidated, all newly laid pipe, or any valved section thereof, shall be subjected to the hydrostatic pressure specified below for that particular type of pipe. The duration of the hydrostatic test shall be at least two (2) hours. Unless otherwise specified or noted on the Plans. All meters, fixtures, devices, or appliances which are connected to the pipeline system, and

which might be damaged if subjected to the specified test pressure shall be disconnected and the ends of the branch lines plugged or capped during the testing procedures.

3. Each valved (capped or plugged) section of pipe shall be filled slowly with water and all air shall be expelled. If permanent air vents are not located at all high points, the Contractor shall install, at his own expense, corporation, or blow-off cocks at such points so that air can be expelled as filling takes place. After verification that all air has been expelled, the cocks shall be closed and the pipe kept filled until tested. All exposed pipe, fittings, valves, hydrants and joints shall be examined while under test pressure and all visible leaks shall be stopped. Any cracked or defective pipe, fittings, valves, or hydrants discovered during testing shall be removed and replaced by the Contractor. Replacement shall be with sound material and the test shall be repeated until satisfactory to the Engineer.

B. Special Requirements: Where any section of pipeline is provided with concrete reaction blocking, the hydrostatic pressure shall not be made until at least five (5) days have elapsed after installation of the blocking. However, if high-early-strength cement is used in the concrete, two (2) days shall have elapsed prior to testing.

C. Leakage Test: A Leakage Test will be conducted on each valved section over the entire Project. The leakage test shall be at 150 psi for at least four (4) hours.

D. Allowable Leakage

1. The allowable hydrostatic leakage rate shall be based on the following formula:

$L = SD\sqrt{P}/133{,}200$

L = testing allowance in gallons per hour
S = length of pipe tested in feet
D = nominal diameter of the pipe in inches
P = average test pressure during the hydrostatic test in pounds per square inch (gauge)

Table 6A - Hydrostatic testing allowance per 1,000 ft of pipeline* - *gph*†

Avg Test psi	Nominal Pipe Diameter, in 3	4	6	8	10	12	14	16	18	20	24	30	36	42	48	54	60	64
450	.48	.64	.95	1.27	1.59	1.91	2.22	2.55	2.87	3.18	3.82	4.78	5.73	6.69	7.64	8.60	9.56	10.19
400	.45	.60	.90	1.20	1.50	1.80	2.10	2.40	2.70	3.00	3.60	4.50	5.41	6.31	7.21	8.11	9.01	9.61
350	.42	.56	.84	1.12	1.40	1.69	1.97	2.25	2.53	2.81	3.37	4.21	5.06	5.90	6.74	7.58	8.43	8.99
300	.39	.52	.78	1.04	1.30	1.56	1.82	2.08	2.34	2.60	3.12	3.90	4.68	5.46	6.24	7.02	7.80	8.32
275	.37	.50	.75	1.00	1.24	1.49	1.74	1.99	2.24	2.49	2.99	3.73	4.48	5.23	5.98	6.72	7.47	7.97
250	.36	.47	.71	.95	1.19	1.42	1.66	1.90	2.14	2.37	2.85	3.56	4.27	4.99	5.70	6.41	7.12	7.60
225	.34	.45	.68	.90	1.13	1.35	1.58	1.80	2.03	2.25	2.70	3.38	4.05	4.73	5.41	6.03	6.76	7.21
200	.32	.43	.64	.85	1.06	1.28	1.48	1.70	1.91	2.12	2.55	3.19	3.82	4.46	5.09	5.73	6.37	6.80
175	.30	.40	.59	.80	.99	1.19	1.39	1.59	1.79	1.98	2.38	2.98	3.58	4.17	4.77	5.36	5.96	6.36
150	.28	.37	.55	.74	.92	1.10	1.29	1.47	1.66	1.84	2.21	2.76	3.31	3.86	4.41	4.97	5.52	5.88
125	.25	.34	.50	.67	.84	1.01	1.18	1.34	1.51	1.68	2.01	2.52	3.02	3.53	4.03	4.53	5.04	5.37
100	.23	.30	.45	.60	.75	.90	1.05	1.20	1.35	1.50	1.80	2.25	2.70	3.15	3.60	4.05	4.50	4.80

If the pipeline under test contains sections of various diameters, the testing allowance will be the sum of the testing allowance for each size.
†Calculated on the basis of Eq. 1.

a. These formulas are based on a testing allowance of 11.65 gpd/mi/in. (1.079 L/d/km/mm) of nominal diameter at a pressure of 150 psi (1,034 kPa).
b. When testing against closed metal-seated valves, an additional testing allowance per closed valve of 0.0078 gal/h/in. (1.2 mL/h/mm) of nominal valve size shall be allowed.
c. When hydrants are in the test section, the test shall be made against the main valve in the hydrant.
d. Acceptance of installation. Acceptance shall be determined on the basis of testing allowance. If any test of laid pipe discloses a testing allowance greater than that specified, repairs or replacements shall be accomplished in accordance with the specifications.
e. All visible leaks are to be repaired regardless of the allowance used for testing.

2. If such testing discloses leakage in excess of this specified allowable, the Contractor, at his expense, shall locate and correct all defects in the pipeline until the leakage is within the specified allowance. All known leaks, regardless of this test, shall be repaired.

E. Pressure Test: After satisfactorily completing the leakage test, each valved section over the entire project, shall be tested at 200 psi for a sufficient period (approximately 10 min) to discover all leaking or defective materials and/or workmanship.

F. Disinfecting Water Mains: The Contractor shall disinfect all water mains before the new facilities are placed into service. Disinfection must be performed in accordance with AWWA C651, latest revision and water samples must be submitted to a laboratory approved by the Texas Department of Health. Sample must be collected by the Contractor or his representative in the presence of the City or his representative. The Contractor shall be responsible for delivering the samples to an approved laboratory for testing. Sample results must indicate the facility is free of microbiological contamination before it is placed into service. It shall be the Contractor's responsibility to obtain a current copy of AWWA C651 to determine the correct forms of chlorine for disinfection, the basic disinfection procedure, preventive and corrective measures during construction, methods of chlorination, final flushing procedures, procedures for bacteriological tests, procedures for redisinfection and disinfection procedures when cutting into existing mains. The Contractor, at its expense, will supply the concentrated chlorine disinfecting material, the City's personnel will supervise and direct the overall sterilization procedure. The Contractor, at his own expense, shall provide all other equipment, supplies, and necessary labor to perform the sterilization under general supervision by the City.

G. General

1. All valves shall be arranged to prevent the strong disinfecting dosage from flowing back into the existing water supply piping. The new pipeline shall then be completely filled with disinfecting solution by feeding the concentrated chlorine and approved water from the existing system uniformly into the new piping in such proportions that every part of the line has a minimum concentration of chlorine as prescribed in AWWA C651.
2. Unless otherwise identified, all quantities called for herein refer to measurements by the testing procedures in the current edition of "Standard Methods of Examination of Water and Wastewater." The chlorine concentration of each step in the sterilization procedure shall be verified by chlorine residual determinations. This disinfecting solution shall be retained in the piping for at least twenty-four (24) hours, and all valves, hydrants, etc., shall be operated to disinfect all their parts. After this retention period, the water shall contain no

less than the chlorine residual prescribed in AWWA C651 throughout the treated section of the pipeline.

3. This heavily chlorinated water shall then be carefully flushed from the line until the chlorine concentration is not higher than the residual generally prevailing in the existing distribution system, or approximately 1.0 parts per million. Proper planning and appropriate preparations to handle, dilute and dispose of this strong chlorine solution without causing injury or damage to the public, the water system, the environment must be approved by the City before flushing of the line may begin, and the flushing shall be witnessed by an authorized representative of the City.

H. Bacteriological Testing

1. After final flushing of the strong disinfecting solution, water samples from the line shall be tested for bacteriological quality, at the Contractor's expense, and must be found free of coliform organisms before the pipeline may be placed in service. One (1) test sample shall be drawn from the end of the main and additional samples collected at intervals of not more than one-thousand (1,000) feet along the pipeline. A minimum of three (3) samples must be collected.
2. The Contractor, at his own expense, shall install sufficient sampling taps at proper locations along the pipeline. Each sampling tap shall consist of a standard corporation cock installed in the line and extended with a copper tubing gooseneck assembly. After samples have been collected, the gooseneck assembly shall be removed and retained for future use.
3. Samples for bacteriological analysis shall be collected only from suitable taps, in sterile bottles. Collection of the test samples shall be made in the presence of City personnel. If the initial disinfection fails to produce acceptable sample tests, the disinfection procedure shall be repeated (without extra compensation) until satisfactory test results have been obtained, before the piping may be placed in service.

END OF SECTION 331110

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331215 - VALVES, HYDRANTS, AND APPURTENANCES

PART 1 - GENERAL

1.1 DESCRIPTION

A. This specification covers the requirements to provide all buried valves, valves in manholes and underground vaults, hydrants and appurtenances complete with actuators and all accessories as shown on the Plans and as specified herein.

1.2 SUBMITTALS

A. Comply with pertinent provisions of Division 1.

B. The Contractor shall submit descriptive information and evidence that the materials and equipment the Contractor proposes for incorporation into the Work is of the kind and quality that satisfies the specified functions and quality.

1.3 REFERENCE STANDARDS

A. Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.

B. American Water Works Association (AWWA)

1. AWWA C500 - Gate Valves, three (3)-inch through 48-inch NPS, for Water and Sewage Systems.
2. AWWA C502 - Dry-Barrel Fire Hydrants.
3. AWWA C509 - Resilient-Seated Gate Valves, three (3) inch through 12-inch NPS, for Water and Sewage Systems.

C. American National Standards Institute (ANSI)

1. ANSI B16.1 - Cast-Iron Pipe Flanges and Flanged Fittings.
2. ANSI C111 - Rubber-Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings.

D. American Society for Testing and Materials (ASTM)

1. ASTM A48 - Gray Iron Castings.
2. ASTM A126 - Gray Iron Castings for Valves, Flanges and Pipe Fittings
3. ASTM A153 - Zinc Coating (Hot-Dip) on Iron and Steel Hardware
4. ASTM A276 - Standard Specification for Stainless and Heat Resisting Steel Bars and Shapes.
5. ASTM A536 - Ductile Iron Castings.

E. Steel Structures Painting Council (SSPC)

1. SSPC SP-6 - Commercial Blast Cleaning

F. Where reference is made to one (1) of the above standards, the revision in effect at the time of bid opening shall apply.

1.4 DELIVERY, STORAGE AND HANDLING

A. Deliver materials to the site to ensure uninterrupted progress of the work.

B. Protect threads and seats from corrosion and damage. Rising stems and exposed stem valves shall be coated with a protective oil film which shall be maintained until time of use.

C. Provide covers for all openings.

1. All valves three (3) inches and larger shall be shipped and stored on site until time of use with wood or plywood covers on each valve end.
2. All valves smaller than three (3) inches shall be shipped and stored as above except that heavy card board covers may be furnished instead of wood.

D. Store equipment to permit easy access for inspection and identification. Any corrosion in evidence at the time of Owner acceptance shall be removed, or the valve shall be removed from the job.

E. Store all equipment in covered storage off the ground.

1.5 COORDINATION

A. Review installation procedures under other Sections and coordinate with the work which is related to this Section including buried piping installation and site utilities.

B. Contractor shall coordinate the location and placement of concrete thrust blocks when required.

1.6 GENERAL

A. All valves shall open counter-clockwise.

B. The use of a Manufacturer’s name and/or model or catalog number is for the purpose of establishing the standard of quality and general configuration desired.

C. Valves shall be of the size shown on the Plans or as noted, and as far as possible equipment of the same type shall be identical and from one Manufacturer.

D. Valves shall have the name of the maker, nominal size, flow directional arrows, working pressure for which they are designed and standard to which they are manufactured cast in raised letters on some appropriate part of the body.

E. Unless otherwise noted, valves shall have a minimum working pressure of 200 psi or be of the same working pressure as the pipe they connect to, whichever is higher, and suitable for the pressures noted where they are installed.

F. Valves shall be of the same nominal diameter as the pipe or fittings they are connected to. Except as otherwise noted, joints shall be mechanical joints, with joint restraint where the adjacent piping is required to be restrained.

G. Valves shall be constructed for buried service.

PART 2 - PRODUCTS

2.1 VALVE BOXES

A. All gate valves shall be provided with extension shafts (where the operating nut is greater than five (5) feet below grade), operating nuts and valve boxes as follows:

1. Extension shafts shall be steel and the operating nut shall be two (2) inches square. Shafts shall be designed to provide a factor of safety of not less than four (4). Operating nuts shall be pinned to the shafts.
2. Valve boxes shall be a heavy-pattern cast iron, three (3) piece, telescoping type box with dome base suitable for installation on the buried valves. Inside diameter shall be at least 5¼-inches. Barrel length shall be adapted to the depth of cover, with a lap of at least six (6) inches when in the most extended position. Covers shall be cast iron with integrally- cast direction-to-open arrow and "WATER" shall be cast in the cover when used on a water line or "SEWER" when used on a wastewater force main. Aluminum or plastic are not acceptable. A means of lateral support for the valve extension shafts shall be provided in the top portion of the valve box. The valve box lid shall be furnished with a pentagon-head bolt for locking.
3. The upper section of each box shall have a bottom flange of sufficient bearing area to prevent settling. The bottom of the lower section shall enclose the stuffing box and operating nut of the valve and shall be oval.
4. An approved operating key or wrench shall be provided.
5. All fasteners shall be Type 304 stainless steel.

2.2 RESILIENT SEATED GATE VALVES

A. Valves shall be manufactured in accordance with AWWA C509. Acceptable Gate Valves are:

1. American Flow Control – Series 2500
2. Mueller – 2360 Series
3. Clow

B. Valves shall be provided with a minimum of two (2) O-ring stem seals.

C. Bonnet and gland bolts and nuts shall be either fabricated from a low alloy-steel for corrosion resistance or electroplated with zinc or cadmium. The hot-dip process in accordance with ASTM A153 is not acceptable.

D. Wedges shall be totally encapsulated with rubber.

E. Units shall be, in addition, UL and FM approved.

F. Resilient wedge gate valves shall be furnished and installed in sizes and shall be manufactured in accordance with the latest AWWA C-509 and cast iron shall conform to the latest ASTM A-126 standards. Gate valves furnished under these specifications shall be of the solid wedge, resilient seat type with cast iron/ductile iron body and bronze stem designed for 250 pounds per square inch working pressure. All gate valves shall be tested hydrostatically to 400 pounds per square inch. Gate valves shall meet the latest AWWA standard specifications (C-509).

G. The seat shall be made of Styrene Butadiene rubber and provide a positive water tight seal. The seat shall be permanently bonded or mechanically attached to the wedge with stainless steel screws. If bonded, ASTM P-429 requirements shall be followed. Non-rising stem gate valves shall be equipped with "O" ring type packing gland consisting of at least two (2) "O" rings. The thrust collar shall work in an "O" ring seal lubricant reservoir or against bearings or washers, above and below constructed of Delrin or approved equal material. Gate valve stems, shall be fabricated from solid bronze rod having a tensile strength of not less than 60,000 pounds per square inch, and a minimum yield strength of 30,000 pounds per square inch.

H. Cast iron body shall be of iron with an even grain and shall possess a tensile strength of not less than 32,000 pounds per square inch. All bronze castings, except the stem, shall have a tensile strength of not less than 30,000 pounds per square inch. The entire internal valve body surfaces shall be coated with a factory applied two (2) component epoxy system or approved equal. The seating surface shall be machined or otherwise constructed to provide a smooth, even surface for the resilient seat. All valves shall open left (counter clockwise) and have a two (2) inch square wrench nut unless specified otherwise.

2.3 TAPPING SLEEVES AND TAPPING VALVES

A. Tapping sleeves shall be of cast iron epoxy coated, designated for working pressure not less than 200 psi. Armored end gaskets shall be provided for the full area of the sleeve flanges. Sleeves shall be as manufactured by A.P. Smith Division of U.S. Pipe, Mueller, Clow, or equal. Nuts and bolts shall be Type 304 stainless steel.

B. Size-on-Size tapping sleeve shall be ductile iron or cast iron.

C. Tapping valves shall conform to the requirements specified above for gate valves except that one (1) end shall be flanged and one (1) mechanical. Tapping valves shall be provided with an oversized opening to permit the use of full size cutters. Tapping valves shall be Ford B81-777 or equal.

2.4 CHECK VALVES

A. Controlled Closing Swing Check Valves (lever & weight)

1. Check valves shall be of the controlled closing swing type. The controlled closing swing check valves shall be guaranteed to operate under severe conditions as check valves. The valve shall be designed to open smoothly, provide full pipe line flow, permit minimum head loss and close at a controlled rate of speed for the final predetermined portion of its stroke. All bolts and nuts used in the assembly shall be steel, commercial.
2. The valve body shall be Cast Iron ASTM A126-B/ductile iron ASTM A536. The disc arm and chamber level shall be of heavy steel construction and keyed to the hinge shaft. The hinge shaft shall be of 18-8 stainless steel and of adequate diameter to withstand a complete hydraulic unbalance pressure of 125 psi on the valve disc. A single cushioning device mounted on the external side of the valve shall control the valve closure by way of the interchange of oil to and from an oil reservoir. The use of air or gas pressurized oil reservoir shall not be permitted. The oil plunger assembly shall be rigidly attached to the valve body by shoulder bolts or dowel pins to prevent fretting.
3. The Manufacturer, if required by the Engineer or the City, shall submit design calculations of principle component stresses to substantiate the integrity of the valve for the working pressure involved.
4. The valve when closed shall be tight seating by way of a resilient replaceable seat against a bronze seat ring in the body.
5. Valves shall be as manufactured by GA Industries or Series 6000 as manufactured by APCO. The City reserves the right to inspect all valves before shipment is made. Any failure of valves to operate satisfactorily during the first year of installation due to faulty workmanship or defective material shall be replaced and made good by the Manufacturer. Under these specifications, any valve stuffing box that leaks for any reason or because of excessive wear or deterioration of packing, shall be reason for classification as defective material.

B. Slanted / Tilted Check Valves

1. Slanted or tilted check valves shall be furnished and installed where shown on the Plans.
2. The body of the valve shall be ductile iron or cast iron with access ports to the disc. The disc shall be cast iron. The seat and disc rings shall be bronze. Pivot pins and bushings shall be bronze or stainless steel. The valve shall include a localized indicator of the position of the valve.
3. The valves shall include a top mounted oil dash pot to prevent slamming of the disc. The dash pot shall control the last 10% of closure of the disc. The speed of closure within this 10% shall be adjustable.
4. Valves shall be APCO Slanting Disc, Valmatic or Golden Anderson Tilted Disc or approved equal.

2.5 FLANGES

A. Flanges shall be cast solid and faced accurately at right angles to the axis of the casting. Dimensions and drilling of flanges shall be in accordance with the American Standard Association for a working pressure of 125 pounds per square inch. Special drilling shall be provided where necessary.

2.6 FIRE HYDRANTS

A. Fire hydrants shall be dry-barrel type conforming to the requirements of the latest revision of AWWA C502. Hydrants shall be designed such that the hydrant valve closes with line pressure preventing loss of water and consequent flooding in the event of traffic damage.

B. Hydrants shall have six (6)-inch mechanical joint inlet connections, two 2½-inch hose connections and one 41/2-inch pumper connection. Threads for the hose and pumper connections shall be in accordance with National Standard Thread. Hydrants shall be according to Manufacturer's standard pattern. Hydrants shall be equipped with "O" ring packing. Each nozzle cap shall be provided with a Buna-N rubber washer.

C. Hydrants shall be so arranged that the direction of outlets may be turned 90 degrees without interference with the drip mechanism or obstructing the discharge from any outlet. The body of the hydrant shall be equipped with a breakable flange, or breakable cast iron flange bolts, just above the grade line.

D. A bronze or rustproof steel nut and check nut shall be provided to hold the main hydrant valve on its stem.

E. Hydrant valve opening shall have an area at least equal to that area of a 41/2-inch minimum diameter circle and be obstructed only by the valve rod. Each hydrant shall be able to deliver 500 gallons minimum through its two 2½-inch hose nozzles when opened together with a loss of not more than two (2) psi in the hydrant.

F. Hydrants shall be designed for installation in a trench that will provide minimum cover as noted on Plans and for the flange to be 3 ½-inches above ground surface. Hydrant extensions shall be as manufactured by the company furnishing the hydrants and of a style appropriate for the hydrants as furnished.

G. Hydrants shall be provided with an automatic and positively operating, non-corrodible drain or drip valve so as to drain the hydrant completely when the main valve is shut. A drain valve operating by springs or gravity is not acceptable.

H. Operating stems whose threads are located in the barrel or waterway shall be of manganese bronze, everdur, or other high-quality non-corrodible metal, and all working parts in the waterway shall be bronze to bronze.

I. Hydrants shall open by turning operating nut to left (counter-clockwise) and shall be marked with a raised arrow and the word "open" to indicate the direction to turn stem to open hydrant.

J. Hydrants shall be furnished with caps, double galvanized steel hose cap chain, galvanized steel pumper hose cap chain, a galvanized steel chain holder and any other hooks and/or appurtenances required for proper use.

K. Hydrant operating nut shall be AWWA Standard pentagonal type measuring 1½-inch point to flat.

L. Hydrants shall be hydrostatically tested as specified in AWWA C502.

M. Hydrants Manufacturer and Type shall be per City requirements

N. All iron work to be set below ground, after being thoroughly cleaned, shall be painted with two (2) coats of asphalt varnish specified in AWWA C502. Iron work to be left above ground shall be factory primed and painted per City requirements using a high-grade enamel paint of quality and color to correspond to the present standard of the City.

O. Fire hydrants shall be installed on the same side of the street or roadway as the water main and shall be installed plumb and true.

P. Heel and thrust blocks shall be placed in undisturbed soil as shown in the details of the Plans.

Q. Double blue reflector "HYE – LITES" brand as manufactured by pavement markers ink shall be installed at the centerline of the street or roadway perpendicular to the hydrant.

2.7 CORPORATION STOPS

A. Corporation stops shall be brass, not less than 1-inch in diameter and shall be installed where shown, specified or required.

B. Provide corporation stops as manufactured by the following:

1. Ford Company

2.8 COMBINATION AIR-VACUUM RELIEF VALVES

A. The air-vacuum release valves shall be installed as shown on the Plans. The valve body shall be of cast iron ASTM A126-B; the floats, float guide, and stem shall be of Type 316 stainless steel. The resilient seat shall be of Buna N. The valve shall be suitable for 150 psig working pressure. Valve shall have standard NPT inlets and outlet ports with diameters as indicated on the Plans. Valve shall be Model 200A Series by APCO Valve and Primer Corporation, Schaumburg, IL, or approved equal.

PART 3 - EXECUTION

3.1 SURFACE PREPARATION AND SHOP COATINGS

A. The interior ferrous metal surfaces, except finished or bearing surfaces, shall be blast cleaned in accordance with SSPC SP-6 and painted with two (2) coats of an approved two (2) component coal tar epoxy coating specifically formulated for potable water use. The coating used must appear on the current edition of the United States Environmental Protection Agency's list entitled "Accepted Categories and Subcategories of Coatings, Liners and Paints for Potable Water Usage."

B. Exterior ferrous metal surfaces of all buried valves and hydrants shall be blast cleaned in accordance with SSPC SP-6 and given two (2) shop coats of a heavy coat tar enamel or an approved two (2) component coat tar epoxy paint.

3.2 INSPECTION AND PREPARATION

A. During installation of all valves and appurtenances, the Contractor shall verify that all items are clean, free of defects in material and workmanship and function properly.

B. All valves shall be closed and kept closed until otherwise directed by the Engineer or the City.

3.3 INTALLATION OF BURIED VALVES AND VALVE BOXES

A. Buried valves shall be cleaned and manually operated before installation. Buried valves and valve boxes shall be set with the stem vertically aligned in the center of the valve box. Valves shall be set on a firm foundation and supported by tamping pipe bedding material under the sides of the valve. The valve box shall be supported during backfilling and maintained in vertical alignment with the top flush with finish grade. The valve box shall be set so as not to transmit traffic loads to the valve.

B. Before backfilling, all exposed portions of any bolts shall be coated with two (2) coats of bituminous paint.

3.4 INSTALLATION OF TAPPING SLEEVES AND VALVES

A. Contact utility owner to coordinate and obtain permission prior to tapping a line. The required procedures and time table shall be followed exactly.

B. Installation shall be made under pressure and flow shall be maintained. The diameters of the tap shall be a minimum of ¼-inch less than the inside diameter of the branch line.

C. The entire operation shall be conducted by workers experienced in the installation of tapping sleeves and valves. The tapping machine shall be furnished by the Contractor.

D. Determine the location of the line to be tapped to confirm that the proposed location will be satisfactory and that no interference will be encountered such as joints or fittings. No tap or sleeve will be made closer than three (3) feet from a pipe joint.

E. A tapping sleeve and valve with boxes shall be set squarely centered on the line to be tapped. Adequate support shall be provided under the sleeve and valve during the tapping operation. Thrust blocks or other permanent restraint shall be provided behind all tapping sleeves. Proper tamping of supporting pipe bedding material around and under the valve and sleeve is mandatory for buried installations.

F. After completing the tap, the valve shall be flushed to ensure that the valve seat is clean. All proper regulatory procedures (including disinfection) shall be followed exactly.

3.5 INSTALLATION OF FIRE HYDRANTS

A. Fire hydrants shall be set at the locations as shown on the Plans and bedded on a firm foundation. Hydrants and connecting pipe shall have at least the same depth of cover as the distributing pipe.

The hydrants shall be set upon a slab of concrete not less than four (4)-inches thick and 15-inches square. During backfilling, additional screened gravel shall be brought up around and six (6) inches over the drain port. Each hydrant shall be set in true vertical alignment and properly braced.

B. 2,500 psi concrete thrust blocks shall be placed between the back of the hydrant inlet and undisturbed soil at the end of the trench. Minimum bearing area shall be as shown on the Plans. Eight (8) mil. Polyethylene film shall be placed around the hydrant elbow before placing concrete. CARE SHALL BE TAKEN TO ENSURE THAT CONCRETE DOES NOT PLUG THE DRAIN PORTS.

C. All connections from the main to the fire hydrants shall be anchoring mechanical joints designed to prevent movement due to thrust or pressure.

D. The hydrant shall be tied to the pipe with suitable rods or clamps, and shall be coated with Koppers 300 or approved equal at a minimum of 8 mil. thick. Bolts shall have a zinc bolt cover per AWWA. Hydrant paint shall be touched up as required after installation.

E. Fire hydrants shall be factory primed and painted as required by City using a high-grade enamel.

3.6 FIELD TESTS AND ADJUSTMENTS

A. Conduct a functional field test of each valve, including actuators and valve control equipment, in presence of Engineer or the Representative of the City to demonstrate that each part and all components together function correctly. All testing equipment required shall be provided by the Contractor at his/her sole expense.

END OF SECTION 331215

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SECTION 333112 - WASTEWATER POLYVINYL CHLORIDE (PVC) PIPE AND FITTINGS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This specification covers the requirements to install and test polyvinyl chloride (PVC) pipe and fittings, including excavation, sheeting, storing, dewatering, pipe laying, jointing, testing, backfilling, and any other work that is required or necessary to complete the installation as shown in the Plans as specified herein.

1.2 SUBMITTALS

A. Comply with pertinent provisions of Division 1.

B. The Contractor shall submit descriptive information and evidence that the materials and equipment the Contractor proposes for incorporation into the Work is of the kind and quality that satisfies the specified functions and quality.

1.3 REFERENCE STANDARDS

A. All PVC pipe and fittings shall be from a single Manufacturer. The Supplier shall be responsible for the provisions of all test requirements specified in ASTM D3034 or ASTM F789 as applicable.

B. Inspections of the pipe may also be made by the Engineer or other representatives of the City after delivery. The pipe shall be subject to rejection at any time on account of failure to meet any of the Specification requirements, even though sample pipes may have been accepted as satisfactory at the place of manufacture. Pipe rejected after delivery shall be marked for identification and shall be removed from the job at once.

PART 2 - PRODUCTS

2.1 POLYVINYL CHLORIDE (PVC) WASTEWATER PIPE AND FITTINGS

A. Pipe and fittings shall be Type PSM, PVC SDR 26 or 35, as indicated on the Drawings, with full diameter dimensions and shall conform to ASTM D3034, or Type PS-46 PVC conforming to ASTM F789, for sizes 4 through 15-inch and shall conform to ASTM F679 for sizes 18 through 27-inch. Straight pipe shall be furnished in lengths of not more than 13-feet and wyes shall be furnished in lengths of not more than three (3) feet. Saddle wyes will not be allowed.

B. PVC pipe and fittings shall have bell and spigot push-on joints. The bell shall consist of an integral wall section with a solid cross-section elastomeric gasket securely locked in place to prevent displacement during assembly. Elastomeric gaskets shall conform to ASTM F477.

C. All fittings and accessories shall have bell and/or spigot configurations compatible with the pipe.

PART 3 - EXECUTION

3.1 HANDLING AND CUTTING PIPE

A. Pipe and fittings are slightly brittle. Care shall be taken in shipping, handling, and laying to avoid damaging the pipe and fittings. Extra care will be necessary during cold weather construction.

B. Any pipe or fitting showing a crack or which has received a blow that may have caused an incipient fracture, even though no such fracture can be seen, shall be marked as rejected and removed at once from the work.

C. All pipe ends shall be square after cutting.

D. While stored, pipe shall be adequately supported from below at not more than three (3) foot intervals to prevent deformation. Pipe shall not be stacked higher than six (6) feet. Pipe and fittings shall be stored in a manner which will keep them at ambient outdoor temperatures and out of direct sunlight. Temporary shading as required to meet this requirement shall be provided. Simple covering of the pipe and fittings which allows temperature buildup when exposed to direct sunlight will not be permitted.

3.2 JOINTING POLYVINYL CHLORIDE (PVC) WASTEWATER PIPE AND FITTINGS

A. PVC wastewater pipe and fittings shall be jointed in accordance with the recommendations of the latest ASTM Standards and detailed instructions of the Manufacturer.

3.3 INTALLATION OF POLYVINYL CHLORIDE (PVC) PIPE AND FITTINGS

A. No single piece of pipe shall be laid unless it is generally straight. The centerline of the pipe shall not deviate from a straight line drawn between the centers of the openings at the ends of the pipe by more than 1/16-inch per foot of length. If a piece of pipe fails to meet this requirement check for straightness, it shall be rejected and removed from the site. Laying instructions of the Manufacturer shall be explicitly followed.

B. Any pipe or fittings discovered to be defective after laying shall be removed and replaced with a sound piece.

C. The Engineer or the City may examine each bell and spigot end to determine whether any preformed joint has been damaged prior to installation. Any pipe having defective joint surfaces shall be rejected, marked as such, and immediately removed from the job site.

D. All pipe shall be sound and clean before laying. When laying is not in progress, including lunch time, the open ends of the pipe shall be closed by watertight plugs or other approved means.

E. Pipe and fittings shall be installed in accordance with the instructions of the Manufacturer, ASTM D2321 and as specified herein. As soon as the excavation is complete to normal grade of the bottom of the trench, bedding shall be placed, compacted, and graded to provide firm, uniform, and continuous support for the pipe. Bell holes shall be excavated so that only the barrel of the pipe bears upon the bedding. The pipe shall be laid accurately to the lines and grades indicated on the Plans. The specified embedment shall be accurately shaped and trimmed to receive the pipe barrel and each pipe section, when in place, shall have a uniform bearing on the subgrade for the full length of the pipe barrel. Pipe shall not be laid unless the subgrade is free of water and in a satisfactory condition. Adjustments of the pipe to line and grade shall be made by scraping away or filling in with granular material, and not by wedging or blocking up the bell. Blocking under the pipe will not be permitted. The bedding as shown in the details of the Plans shall be placed evenly on each side of the pipe to mid-diameter and hand tools shall be used to force the bedding under the haunches of the pipe and into the bell holes to give firm continuous support for the pipe. The bedding shall then be placed to 12-inches above the top of the pipe. The initial three (3) feet of backfill above the bedding backfill shall be placed in eight (8) inch layers and carefully compacted. Generally, the compaction shall be done evenly on each side of the pipe and compaction equipment shall not be operated directly over the pipe until sufficient backfill has been placed to ensure that such compaction equipment will not have a damaging effect on the pipe. Equipment used in compacting the initial three (3) feet of backfill shall be approved by the pipe Manufacturer's representative prior to use.

F. Joints shall not be "pulled" or "cramped." Each joint of pipe shall be completed in compliance with Manufacturer's recommendations.

G. Before any joint is made, the pipe shall be checked to assure that a close joint with the next adjoining pipe has been maintained and that the inverts are matched and conform to the required grade. The pipe shall not be driven down to grade by striking it.

H. Precautions shall be taken to prevent flotation of the pipe in the trench.

I. When moveable trench bracing such as trench boxes, moveable sheeting, shoring, or plates are used to support the sides of the trench, care shall be taken in placing and moving the boxes or supporting bracing to prevent movement of the pipe, or disturbance of the pipe bedding and the backfill. Trench boxes, moveable sheeting, shoring or plates shall not be allowed to extend below mid-diameter of the pipe. As trench boxes, moveable sheeting, shoring, or plates are moved, screened material shall be placed to fill any voids created and the screened material and backfill shall be re-compacted to provide uniform side support for the pipe.

J. Pipe stubs for manhole connections shall not exceed 3.25-feet in length unless directed otherwise by the Engineer or the City. Install caps where required. When connecting to an existing manhole, the opening for the connection of the wastewater pipe and the manhole shall be cored using an approved coring machine to the dimensions and size required to install the flexible "SEAL BOOT" resilient connector that meets the requirements of ASTM C-923. The connection shall be watertight when complete.

K. Wastewater mains will be installed in straight trenches from manhole to manhole or manhole to cleanout. There will be no curvilinear installations of wastewater mains.

3.4 TESTING

A. Scope: After sewers and manholes have been installed and backfilled, subject newly laid gravity lines and manholes to a leakage test. Contractor to furnish all labor, materials, tools, and equipment to test lines. Take such precautions as required to prevent damage to lines and appurtenances being tested. Repair any damage resulting from test at Contractor's expense. If required, conduct test in presence of Engineer or designated City Representative.

B. Test Procedures for Leakage Test of Gravity Sewer: Contractor, at his option, may test lines by hydrostatic or low-pressure air test as specified below. However, the Engineer may direct a specific test be performed in specified areas of the Project.

C. Exfiltration Test (for Gravity Sewer)

1. Preparation: Seal ends of line section being tested with watertight plugs, equipped with pipe riser inserted and braced in the inlet of the manholes. Fill section with water 24-hours prior to start of test. Fill slowly from downstream manhole in test section so that no air is trapped in the line. Leave outlets of stacks and service lines exposed and unplugged until after exfiltration test has been made. Outlets terminating below level of test water surface to be temporarily extended upward by installing additional lengths of pipe. After completion of satisfactory test, remove lengths of pipe added for test.
2. Duration of Test: Test for 24-hours. Minimum head of either two (2) feet measured above the crown, inside pipe at upper end of section or four (4) feet measured above trench water table, whichever is higher, so that a net positive of two (2) feet is used for testing.
3. Allowable Leakage: Allowable leakage or exfiltration in any individual section under construction shall not exceed 25 gallons per inch of inside diameter per mile of pipe per 24 hours.

D. Low Pressure Air Test of Plastic Gravity Flow Wastewater Lines

1. General:
2. Wastewater lines, at the discretion of the ENGINEER, shall be air tested between manholes. Backfilling to grade shall be completed before the test and all laterals and stubs shall be capped or plugged by the Contractor so as not to allow air losses, which could cause an erroneous test result. Manholes shall be plugged so they are isolated from the pipe and cannot be included in the test.
3. All plugs used to close the sewer for the air test shall be capable of resisting the internal pressures and must be securely braced. Place all air testing equipment above ground and allow no one to enter a manhole or trench where a plugged sewer is under pressure.
4. Release all pressure before the plugs are removed. The testing equipment used must include a pressure relief device designed to relieve pressure in the sewer under test at 10 psi or less and must allow continuous monitoring of the test pressures in order to avoid excessive pressure. Use care to avoid the flooding of the air inlet by infiltrated ground water. (Inject the air at the upper plug if possible.) Use only qualified personnel to conduct the test.
5. Ground Water
6. Since the presence of ground water will affect the test results, test holes shall be dug to the pipe zone at intervals of not more than 100 feet and the average height of ground water above the pipe (if any) shall be determined before starting the test.
7. Test Procedure

The ENGINEER may, at any time, require a calibration check of the instrumentation used. Use a pressure gauge having minimum divisions of 0.10 psi and an accuracy of 0.0625 psi. (One ounce per square inch.) All air used shall pass through a single control panel.
Clean the sewer to be tested and remove all debris where indicated. Wet the sewer prior to testing. The average back pressure of any groundwater shall be determined (0.433 psi) for each foot of average water depth (if any) above the sewer.

Add air slowly to the section of sewer being tested until the internal air pressure is raised to 4.0 psig greater than the average back pressure of any ground water that may submerge the pipe. After the internal test pressure is reached, allow at least 2 minutes for the air temperature to stabilize, adding only the amount of air required to maintain pressure. After the temperature stabilization period, disconnect the air supply. Determine and record the time in seconds that is required for the internal air pressure to drop from 3.5 psig to 2.5 psig greater than the average backpressure of any ground water that may submerge the pipe. Compare the time recorded with the specification time for the size and length of pipe as given in the following table:

Table for Low Pressure Air Testing of Plastic Pipe:

Minimum Specified Time Required For 1.0 psig Pressure Drop for Size and Length of Pipe								
Diameter of Pipe,	Specification Time (min: sec) for length shown							
	100 ft	150 ft	200 ft	250 ft	300 ft	350 ft	400 ft	450 ft
4	3:46	3:46	3:46	3:46	3:46	3:46	3:46	3:46
6	5:40	5:40	5:40	5:40	5:40	5:40	5:42	6:24
8	7:34	7:34	7:34	7:34	7:36	8:52	10:08	11:24
10	9:26	9:26	9:26	9:53	11:52	13:51	15:49	17:48
12	11:20	11:20	11:24	14:15	17:05	19:56	22:47	25:38
15	14:10	14:10	17:48	22:15	26:42	31:09	35:36	40:04
18	17:00	19:13	25:38	32:03	38:27	44:52	51:16	57:41
21	19:50	26:10	34:54	43:37	52:21	61:00	69:48	78:31
24	22:47	34:11	45:34	56:58	68:22	79:46	91:10	102:33
27	28:51	43:16	57:41	72:07	86:32	100:57	115:22	129:48
30	35:37	53:25	71:13	89:02	106:50	124:38	142:26	160:15
33	43:05	64:38	86:10	107:43	129:16	150:43	172:21	193:53
36	51:17	76:55	102:34	128:12	153:50	179:29	205:07	230:46

NOTES: 1. Specification times are as given in UNI-B-6 RECOMMENDED PRACTICE FOR LOW- PRESSURE TESTING OF INSTALLED PIPE -- by Uni-Bell PVC Pipe Association, 2655 Villa Creek Dr., Ste. 155, Dallas Texas 75234.
Any drop in pressure, from 3.5 psig to 2.5 psig (adjusted for groundwater level), in a time less than that required by the above table shall be cause for rejection. When the line tested includes more than one size pipe, the minimum time shall be that given for the largest size pipe included.

E. Deflection Testing

1. Deflection tests shall be performed on all flexible pipes. For pipes with inside diameters less than 27-inches, a rigid mandrel shall be used to measure deflection. The test shall be

conducted after final backfill has been in place at least 30 days in the presence of a representative of the City's Utilities Department. No pipe shall exceed a deflection of five percent (5%). If a pipe should fail to pass the deflection test, the problem shall be corrected, and a second test shall be conducted after the final backfill has been in place an additional 30 days. Test shall be performed without mechanical pulling devices.

2. Mandrel Sizing: The rigid mandrel shall have an outside diameter (O.D.) equal to 95% of the inside diameter (I.D.) of the pipe. The inside diameter of the pipe, for the purpose of determining the outside diameter of the mandrel, shall be the average outside diameter of the pipe minus two minimum wall thickness for O.D. controlled pipe and the average inside diameter for the I.D. Controlled pipe, all dimensions shall be per appropriate standard. Statistical or other "tolerance packages" shall not be considered in mandrel sizing.
3. Mandrel Design: The rigid mandrel shall be constructed of a metal or rigid plastic material that can withstand 200 psi without being deformed. The mandrel shall have nine or more "runners" or "legs" as long as the total number of legs is an odd number. The barrel section of the mandrel shall have a length of at least 75% of the inside diameter of the pipe. A proving ring shall be provided and used for each size mandrel in use.

F. Repairs of Lines:

Remove and replace or make approved corrective repairs to any section of line or manhole which has leakage that exceeds above amounts. Repair any individual leaks that may appear whether or not overall section meets leakage requirements. Individual leaks will ordinarily be revealed by looking through sewer with a light while groundwater level is over sewer, during water tamping operations or immediately after water leakage is emptied from sewer.

G. Retest:

Sewers and/or manholes failing to meet requirements of leakage test will, after repair by Contractor, be tested again for leakage. No sewer or manhole will be accepted until leakage is less than allowable amount.

H. Video Inspection

1. The use of a television camera for inspection prior to placing the sewer in service will be performed if required by the Owner. Video inspection is at the cost of the Contractor, and copies of the videotapes will be presented to the City prior to final acceptance. One (1) copy of the videotapes shall be submitted to the City.
2. Post construction video of the gravity wastewater lines will be evaluated on a case-by-case basis for acceptance. Preparation for videotaping of wastewater line shall be as follows:

    a. Flush and clean the gravity wastewater line prior to videotaping.
    b. The videotape shall display the station, in accordance with the Plans and Standards, and counter on the screen. Manhole numbers and stations shall correspond to the contract documents.
    c. If debris is evident in the line during the video, the line will be flushed and cleaned to allow a clean video.
    d. All manholes will be identified at the beginning and end of the video corresponding to contract documents with upstream and downstream ends identified.

END OF SECTION 333112

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SECTION 333913 - WASTEWATER CONCRETE MANHOLES

PART 1 - GENERAL

1.1 DESCRIPTION

A. This specification covers the requirements to install precast concrete manholes, frames and covers, and appurtenances as shown on the Plans and as specified herein.

1.2 SUBMITTALS

A. Comply with pertinent provisions of Division 1.

B. The Contractor shall submit descriptive information and evidence that the materials and equipment the Contractor proposes for incorporation into the Work is of the kind and quality that satisfies the specified functions and quality.

1.3 REFERENCE STANDARDS

A. American Society for Testing and Materials (ASTM)

1. ASTM A48 - Specification for Gray Iron Castings.
2. ASTM A615 - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
3. ASTM C33 - Specification for Concrete Aggregates.
4. ASTM C150 - Standard Specification for Portland Cement.
5. ASTM C478 - Standard Specification for Precast Reinforced Concrete Manhole Sections.
6. ASTM D4101 - Specification for Propylene Plastic Injection and Extrusion Materials.

B. American Concrete Institute (ACI)

1. ACI 318 - Building Code Requirements for Reinforced Concrete.
2. ACI 350R - Concrete Sanitary Engineering Structures.

C. American Association of State Highway and Transportation Officials (AASHTO)

1. Standard Specifications for Highway, Streets and Bridges.

D. Occupational Safety and Health Administration (OSHA)

E. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.4 QUALITY ASSURANCE

A. All material shall be new and unused.

B. Materials' quality, manufacturing process and finished sections are subject to inspection and approval by Engineer or other City representative.

C. Materials will be examined for compliance with ASTM specifications, these Specifications, and approved Manufacturer's drawings. Additional inspection criteria shall include appearance, dimensions(s), blisters, cracks, and soundness.

D. Materials shall be rejected for failure to meet any Specification requirement. Mark for identification rejected materials and remove from work site immediately. Rejected materials shall be replaced at no cost to Owner.

E. Repair minor damage to precast concrete sections by approved method if repair is authorized by Engineer or the City.

PART 2 - PRODUCTS

2.1 GENERAL

A. Reference to a Manufacturer's name and model or catalog number is for the purpose of establishing the standard of quality and general configuration desired.

B. Like items of materials/equipment shall be the end products of one Manufacturer in order to provide standardization for appearance, operation, maintenance, spare parts, and Manufacturer's service.

C. Provide lifting lugs or holes in each precast section for proper handling.

2.2 PRECAST CONCRETE MANHOLE SECTIONS

A. Precast concrete base sections, riser sections, transition top sections, flat slab tops and grade rings shall conform to ASTM C478 and meet the following requirements:

1. Bottom slab thickness shall be 12-inches.
2. Base, riser and transition top sections shall have tongue and groove joints.
3. Sections shall be cured by an approved method.
4. Precast concrete sections shall be shipped after concrete has attained 3,000 psi compressive strength.
5. Design precast concrete base, riser, transition top, flat slab top and grade ring for a minimum HS-20 loading plus earth load. Calculate earth load with a unit weight of 130 pounds per cubic foot.
6. Mark date of manufacture, name, and trademark of Manufacturer on the inside of each precast section.
7. Construct and install precast concrete base as shown on the Plans.

8. Provide integrally cast knock-out panels in precast concrete manhole sections at locations, and with sizes shown on Plans. Knock-out panels shall have no steel reinforcing.
9. Shall have a factory applied internal coating of Raven Line 405 or approved equal.

B. Manhole diameter shall be as shown on the Plans, but not less than the diameter of the largest connecting pipe plus two (2) feet.

C. Pipe Sections:

1. Pipe sections shall conform to current specifications for Precast Reinforced Manhole Sections, ASTM Designation C478.
2. Minimum wall thickness for the manhole risers shall be as listed under Wall "B" in the "Class Tables" of ASTM C76 for Class III pipe.

D. Joints

1. Joints shall conform to the joint specifications in ASTM C478, C76, and ASTM C443. All manhole sections, including the bottom section, shall be furnished with "O-ring" type rubber gasket joints. The joints shall be furnished and installed with the bell down to resist groundwater infiltration. All joints shall be sealed with mortar or an approved non-shrink grout on the inside and the outside of the manhole. Grade rings shall be mortared to each other and on the inside and outside to provide a waterproof seal.

E. Manhole Steps

1. Unless specifically approved by the City, manhole steps shall not be provided.

2.3 MANHOLE FRAME AND COVER

A. Manhole frames and covers shall be of good quality, strong, tough, even grained cast iron, smooth, free from scale, lumps, blisters, sand holes and defects of any kind which render them unfit for the service for which they are intended. Manhole covers and frame seats shall be machined to a true surface. Castings shall be thoroughly cleaned and subject to hammer inspection. Cast iron shall conform to ASTM A48, Class 30.

B. Manhole covers shall have a diamond pattern, pickholes and the word SEWER as appropriate cast in three (3) inch letters. Manhole frame and covers shall be Neenah Foundry, Western Iron Works, Vulcan Foundry, or equal.

2.4 JOINTING PRECAST MANHOLE SECTIONS

A. Seal tongue and groove joints of precast manhole sections with rubber "O"-ring gasket. O-ring gasket shall conform to ASTM C443.

B. Completed joint shall withstand 15 psi internal water pressure without leakage or displacement of gasket or sealant.

2.5 PIPE CONNECTIONS TO MANHOLE

A. Connect pipe to manhole in the following ways:

1. Flexible sleeve - Integrally cast sleeve in precast manhole section or install sleeve in a formed or cored opening. Fasten pipe in sleeve with stainless steel clamp(s). Coat stainless steel clamp(s) with bituminous material to protect from corrosion. Flexible sleeve shall be Lock Joint Flexible Manhole Sleeve; Kor-N-Seal connector; PSX Press-Seal Gasket or equal.
2. Compression gasket - Integrally cast compression gasket in precast manhole section. Insert pipe into compression gasket. Compression gasket shall be A-Lok, or equal.

PART 3 - EXECUTION

3.1 MANHOLE INSTALLATION

A. Manholes shall be constructed to the dimensions shown on the Plans and as specified herein. Protect all work against flooding and flotation.

B. Place manhole base on a bed of screened gravel eight (8) inches in depth as shown on the Plans. Set manhole base so that a maximum grade adjustment of eight (8) inches is required to bring the manhole frame and cover to final grade. Use precast concrete grade rings to adjust manhole frame and cover to final grade.

C. Set precast concrete barrel sections plumb with a ¼-inch maximum out of plumb tolerance allowed. Seal joints of precast barrel sections with either a rubber "O" ring set in a recess or preformed flexible joint sealant in sufficient quantity to fill 75 percent of the joint cavity. Fill the outside and inside joint with non-shrink mortar and finished flush with the adjoining surfaces. Caulk the inside of any leaking barrel section joint with non-shrink grout.

D. Allow joints to set for 14 hours before backfilling unless a shorter period is specifically approved by the Engineer or the City.

E. Plug holes in the concrete barrel sections required for handling with a non-shrinking grout or non-shrinking grout in combination with concrete plugs. Finish flush on the inside.

F. Core holes in precast sections to accommodate pipes prior to setting manhole sections in place to prevent jarring which may loosen the mortar joints.

G. Backfill carefully and evenly around manhole sections.

3.2 MANHOLE PIPE CONNECTIONS

A. Construct manhole pipe connections, including pipe stubs, as specified above. Close or seal pipe stubs for future connections with a gasketed watertight plug.

3.3 SETTING MANHOLE FRAME AND COVER

A. Set manhole covers and frames in a full mortar bed. Utilize precast concrete grade rings, a maximum of eight (8) inches thick, to assure frame and cover are set to the finished grade. Set manhole frame and cover to final grade prior to placement of permanent paving.

3.4 MANHOLE TESTING

A. If required, Contractor shall schedule testing such that Engineer or the City's representative can observe each test.

B. Test Procedures for Hydrostatic Test for Manholes

1. Manholes shall be tested for leakage separately and independently of the wastewater lines by vacuum testing, or other methods acceptable to the Engineer. If a manhole fails a leakage test, the manhole must be made watertight and retested. The maximum leakage for hydrostatic testing shall be 0.025 gallon per vertical foot per hour. Alternative test methods must ensure compliance with the above allowable leakage. Hydrostatic exfiltration testing shall be performed as follows: all wastewater lines coming into the manhole shall be sealed with an internal pipe plug, then the manhole shall be filled with water and maintained full for at least one (1) hour. For concrete manholes, a wetting period of 24-hours may be used prior to testing in order to allow saturation of the concrete.

C. Test Procedures for Vacuum Testing Manholes

1. Where groundwater is present, manholes shall be tested by vacuum. Manholes testing by vacuum shall be performed by the Contractor in compliance with these specifications.
2. Manholes shall be tested after installation of all connections (existing and/or proposed) in place. All lift holes shall be plugged with an approved non-shrink grout and all drop connections and gas sealing connections shall be installed prior to testing. The lines entering the manhole shall be temporarily plugged with the plugs braced to prevent them from being drawn into the manhole. The plugs shall be installed in the lines beyond the drop- connections, gas sealing connections, etc. The test head shall be placed inside the frame at the top of the manhole and inflated in accordance with the manufacturer's recommendations. A vacuum of 10-inches of mercury shall be drawn, and the vacuum pump shall be turned off. With the valve closed, the level of vacuum shall be read after the required test time. If the drop in the level is less than one (1) inch of mercury (final vacuum of nine (9) inches of mercury), the manhole will have passed the vacuum test. The required test time shall be 90- seconds.
3. Manholes which have a final vacuum of nine (9) inches of mercury after the time indicated will be accepted. If there has been no pressure loss during the first 75-seconds, the test may be stopped, and the manhole will be accepted. Any manhole which fails the vacuum test as described above shall be repaired with an approved non-shrink grout or other material acceptable to the Engineer and the City based on the material from which the manhole is constructed. The manhole shall be retested as described above until a successful test is made.

3.5 CLEANING

A. Thoroughly clean all new manholes of all silt, debris, and foreign matter of any kind, prior to final inspections.

END OF SECTION 333913

SECTION 334100 - STORM UTILITY DRAINAGE PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes gravity-flow, nonpressure storm drainage outside the building, with the following components:

1. Site storm sewer drainage piping, fittings, accessories, and bedding.
2. Catch basins, paved area drains, site surface drains and stormwater detention facilities.
3. Connection of building storm water drainage system.
4. Precast concrete, Cast-in-place concrete manholes.

B. All public work to be performed and materials to be used within the street right-of-way shall be in accordance with the City of Austin Design Standards. In the event of a discrepancy between the above-referenced standards, the plans, and/or any portion of this specification section, the order of precedence will be the plans, the City Design Standards, and then these specifications. The Contractor shall contact the engineer in the event of a discrepancy.

1.2 DEFINITIONS

A. PVC: Polyvinyl chloride plastic.

B. HDPE: High density polyethylene.

C. RCP: Reinforced concrete pipe

1.3 PERFORMANCE REQUIREMENTS

A. Gravity-Flow, Nonpressure, Drainage-Piping Pressure Rating: 10-foot head of water. Pipe joints shall be at least silttight, unless otherwise indicated.

1.4 SUBMITTALS

A. Product Data: For the following:

1. Pipe materials, fittings, and accessories.
2. Drains.

B. Shop Drawings: For the following:

1. Manholes: Include plans, elevations, sections, details, and frames and covers. Catch Basins and Stormwater Inlets. Include plans, elevations, sections, details, and frames, covers, and grates.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Do not store plastic manholes, pipe, and fittings in direct sunlight.

B. Protect pipe, pipe fittings, and seals from dirt and damage.

C. Handle manholes according to manufacturer's written rigging instructions.

D. Handle catch basins and stormwater inlets according to manufacturer's written rigging instructions.

1.6 PROJECT CONDITIONS

A. Interruption of Existing Storm Drainage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:

1. Notify Engineer and Owner no fewer than two days in advance of proposed interruption of service.

PART 2 - PRODUCTS

2.1 PVC PIPE AND FITTINGS

A. PVC Sewer Pipe and Fittings; NPS 6” to 12” ASTM D 3034, SDR 26, with bell-and-spigot ends for gasketed joints with ASTM F 477, elastomeric seals.

2.2 CONCRETE PIPE AND FITTINGS

A. Reinforced-Concrete Sewer Pipe and Fittings: ASTM C 76, with groove and tongue ends and gasketed joints with ASTM C 443, rubber gaskets.

1. Class III, Wall B.

2.3 HDPE PIPE AND FITTINGS

A. Pipe shall have a smooth interior and exterior corrugations.

1. 4-through 10-inch (100 to 250 mm) shall meet AASHTO M252m, Type S.
2. 12- through 60-inch (300 to 1500 mm) shall meet AASHTO M294, Type S or ASTM F2306.

B. Pipe shall be joined with joints meeting the requirements of AASHTO M252, AASHTO M294, or ASTM F2306.

C. 4-through 60-inch (100 to 1500mm) shall be watertight according to the requirements of ASTM D3212. Gaskets shall be made of polyisoprene meeting the requirements of ASTM F477.

D. Gaskets shall be installed by the pipe manufacturer and covered with a removable, protective wrap to ensure the gasket is free from debris. A joint lubricant available from the manufacturer shall be used on the gasket and bell during assembly.

E. 12- through 60-inch (300 to 1500 mm) diameters shall have a reinforced bell with a bell tolerance device. The bell tolerance shall be installed by the manufacturer.

F. Fittings shall conform to AASHTO M252, AASHTO M294, or ASTM F2306.

G. To assure watertightness, field performance verification may be accomplished by testing in accordance with ASTM C969. Appropriate safety precautions must be used when field-testing any pipe material.

H. Installation shall be in accordance with ASTM D2321 and manufacturer's published installation guidelines, with the exception that minimum cover in trafficked areas for 4- through 48-inch (100 to 1200 mm) diameters shall be one foot. (0.3 m) and for 60-inch (1500 mm) diameters, the minimum cover shall be 2 ft. (0.6 m) in single run applications.

2.4 NONPRESSURE-TYPE PIPE COUPLINGS

A. Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition coupling, for joining underground nonpressure piping. Include ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.

B. Sleeve Materials:

1. For Concrete Pipes: ASTM C 443, rubber.
2. For Cast-Iron Soil Pipes: ASTM C 564, rubber.
3. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
4. For Dissimilar Pipes: ASTM D 5926, PVC, or other material compatible with pipe materials being joined.

2.5 CLEANOUTS AND PLUGS

A. Installation shall be in accordance with the details and at locations shown on the drawings.

B. All cleanouts shall have a 2' x 2' x 6" thick concrete apron.

2.6 MANHOLES

A. Standard Precast Concrete Manholes: ASTM C 478, precast, reinforced concrete, of depth indicated, with provision for sealant joints.

1. Diameter: 48 inches minimum, unless otherwise indicated.

2. Ballast: Increase thickness of precast concrete sections or add concrete to base section, as required to prevent flotation.
3. Base Section: 6-inch minimum thickness for floor slab and 4-inch minimum thickness for walls and base riser section and having separate base slab or base section with integral floor.
4. Riser Sections: 4-inch minimum thickness, and lengths to provide depth indicated.
5. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated. Top of cone of size that matches grade rings.
6. Joint Sealant: ASTM C 990, bitumen or butyl rubber.
7. Steps: Individual FRP steps or FRP ladder, wide enough to allow worker to place both feet on 1 step and designed to prevent lateral slippage off of step. Cast or anchor steps into sidewalls at 12- to 16-inch intervals. Omit steps if total depth from floor of manhole to finished grade is less than 60 inches.
8. Grade Rings: Reinforced-concrete rings, 6- to 9-inch total thickness, to match diameter of manhole frame and cover.
9. Manhole Frames and Covers: Ferrous; 28-inchID by 7- to 9-inch riser with 4-inch-minimum width flange and 30-inch-diameter cover. Include indented top design with lettering cast into cover, using wording equivalent to "STORM SEWER."

    a. Material: ASTM A 536, Grade 60-40-18 ductile iron, unless otherwise indicated.

B. Cast-in-Place Concrete Manholes: Construct of reinforced-concrete bottom, walls, and top; designed according to ASTM C 890 for A-16 (ASSHTO HS20-44), heavy-traffic, structural loading; of depth, shape, dimensions, and appurtenances indicated.

1. Ballast: Increase thickness of concrete, as required to prevent flotation.
2. Resilient Pipe Connectors: ASTM C 923, cast or fitted into manhole walls, for each pipe connection.
3. Steps: Individual FRP steps or FRP ladder, wide enough to allow worker to place both feet on 1 step and designed to prevent lateral slippage off of step. Cast or anchor steps into sidewalls at 12- to 16-inch intervals. Omit steps if total depth from floor of manhole to finished grade is less than 60 inches.
4. Adjusting Rings: Interlocking rings with level or sloped edge in thickness and diameter matching manhole frame and cover. Include sealant recommended by ring manufacturer.
5. Grade Rings: Reinforced-concrete rings, 6- to 9-inch (150- to 225-mm) total thickness, to match diameter of manhole frame and cover.
6. Manhole Frames and Covers: Ferrous; 28-inchID by 7- to 9-inch riser with 4-inch-minimum width flange and 30-inch-diameter cover. Include indented top design with lettering cast into cover, using wording equivalent to "STORM SEWER."

    a. Material: ASTM A 536, Grade 60-40-18 ductile iron, unless otherwise indicated.
    b. Protective Coating: Foundry-applied, SSPC-Paint 16, coal-tar, epoxy-polyamide paint; 10-mil minimum thickness applied to all surfaces, unless otherwise indicated.

2.7 CONCRETE

A. General: Cast-in-place concrete according to ACI 318/318R, ACI 350R, and the following:

1. Cement: ASTM C 150, Type II.

2. Fine Aggregate: ASTM C 33, sand.
3. Coarse Aggregate: ASTM C 33, crushed gravel.
4. Water: Potable.

B. Portland Cement Design Mix: 4000 psi minimum, with 0.45 maximum water-cementitious materials ratio.

1. Reinforcement Fabric: ASTM A 185, steel, welded wire fabric, plain.
2. Reinforcement Bars: ASTM A 615/A 615M, Grade 60, deformed steel.

C. Ballast and Pipe Supports: Portland cement design mix, 3000 psi minimum, with 0.58 maximum water-cementitious materials ratio.

1. Reinforcement Fabric: ASTM A 185, steel, welded wire fabric, plain.
2. Reinforcement Bars: ASTM A 615/A 615M, Grade 60, deformed steel.

2.8 CATCH BASINS

A. Installation shall be in accordance with the details and at locations shown on the drawings.

2.9 STORMWATER INLETS

A. Curb Inlets: Made with vertical curb opening, of materials and dimensions according to the details and at locations shown on plans.

B. Frames and Grates: Heavy-duty frames and grates according to the details and at locations shown on plans.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavation, trenching, and backfilling are specified in Division 31 Section "Earth Moving."

3.2 PIPING APPLICATIONS

A. Pipe couplings and special pipe fittings with pressure ratings at least equal to piping rating may be used in applications below, unless otherwise indicated.

1. Use nonpressure-type flexible couplings where required to join gravity-flow, nonpressure sewer piping, unless otherwise indicated.

a. Unshielded flexible couplings for same or minor difference OD pipes.
b. Unshielded, increaser/reducer-pattern, flexible or rigid couplings for pipes with different OD.

c. Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.

B. Special Pipe Fittings: Use for pipe expansion and deflection. Pipe couplings and special pipe fittings with pressure ratings at least equal to piping rating may be used in applications below, unless otherwise indicated.

C. Gravity-Flow, Nonpressure Sewer Piping: As shown on plans.

3.3 PIPING INSTALLATION

A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground storm drainage piping. Location and arrangement of piping layout take design considerations into account. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.

B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.

C. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.

D. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.

E. Tunneling: Install pipe under streets or other obstructions that cannot be disturbed by tunneling, jacking, or a combination of both.

F. Install gravity-flow, nonpressure drainage piping according to the following:

1. Install piping NPS 6 (DN 150) and larger with restrained joints at tee fittings and at changes in direction. Use corrosion-resistant rods, pipe or fitting manufacturer's proprietary restraint system, or cast-in-place concrete supports or anchors.
2. Install piping with 36-inch (915-mm) minimum cover.
3. Install PVC sewer piping according to ASTM D 2321 and ASTM F 1668.
4. Install reinforced-concrete sewer piping according to ASTM C 1479 and ACPA's "Concrete Pipe Installation Manual."

    a. Install HDPE pipe according to ASTM D2321.

3.4 PIPE JOINT CONSTRUCTION

A. Where specific joint construction is not indicated, follow piping manufacturer's written instructions.

B. Join gravity-flow, nonpressure drainage piping according to the following:

1. Join PVC sewer piping according to ASTM D 2321 and ASTM D 3034 for elastomeric-seal joints or ASTM D 3034 for elastomeric gasket joints.
2. Join reinforced-concrete sewer piping according to ACPA's "Concrete Pipe Installation
3. Manual" for rubber-gasket joints.
4. Join dissimilar pipe materials with nonpressure-type flexible or rigid couplings.

C. Join dissimilar pipe materials with pressure-type couplings.

3.5 CLEANOUT INSTALLATION

A. Install cleanouts and riser extension from sewer pipe to cleanout at grade. Use cast-iron soil pipe fittings in sewer pipes at branches for cleanouts and cast-iron soil pipe for riser extensions to cleanouts. Install piping so cleanouts open in direction of flow in sewer pipe.

1. Use heavy-duty, top-loading classification cleanouts in vehicle-traffic service areas.
2. Use extra-heavy-duty, top-loading classification cleanouts in firelane areas.

B. Set cleanout frames and covers in earth in cast-in-place concrete block, 24 by 24 by 6 inchesdeep. Set with tops 1 inch above surrounding earth grade.

C. Set cleanout frames and covers in concrete pavement with tops flush with pavement surface.

3.6 DRAIN INSTALLATION

A. Install type of drains in locations indicated.

1. Use heavy-duty, top-loading classification drains in vehicle-traffic service areas.
2. Use extra-heavy-duty, top-loading classification drains in roads areas.

B. Embed drains in 4-inch minimum depth of concrete around bottom and sides.

C. Fasten grates to drains if indicated.

D. Set drain frames and covers with tops flush with pavement surface.

E. Assemble trench sections with flanged joints.

F. Embed trench sections in 4-inch minimum concrete around bottom and sides.

3.7 MANHOLE INSTALLATION

A. General: Install manholes, complete with appurtenances and accessories indicated.

B. Install precast concrete manhole sections according to ASTM C 891.

C. Construct cast-in-place manholes as indicated.

3.8 CATCH BASIN INSTALLATION

A. Construct catch basins to sizes and shapes indicated.

B. Set frames and grates to elevations indicated.

3.9 STORMWATER INLET AND OUTLET INSTALLATION

A. Construct inlet head walls, aprons, and sides of reinforced concrete, as indicated.

B. Install outlets that spill onto grade, anchored with concrete, where indicated.

C. Install outlets that spill onto grade, with flared end sections that match pipe, where indicated.

D. Construct energy dissipaters at outlets, as indicated.

3.10 CONCRETE PLACEMENT

A. Place cast-in-place concrete according to ACI 318/318R.

3.11 FIELD QUALITY CONTROL

A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.

1. Submit separate reports for each system inspection.
2. Defects requiring correction include the following:

    a. Alignment: Less than full diameter of inside of pipe is visible between structures.
    b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
    c. Crushed, broken, cracked, or otherwise damaged piping.
    d. Infiltration: Water leakage into piping.
    e. Exfiltration: Water leakage from or around piping.

3. Replace defective piping using new materials and repeat inspections until defects are within allowances specified.
4. Reinspect and repeat procedure until results are satisfactory.

B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.

1. Do not enclose, cover, or put into service before inspection and approval.
2. Test completed piping systems according to authorities having jurisdiction.
3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
4. Submit separate report for each test.

C. Replace leaking piping using new materials and repeat testing until leakage is within allowances specified.

3.12 CLEANING

A. Clean interior of piping of dirt and superfluous materials. Flush with potable water.

END OF SECTION 334100

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